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UNDERSØGELSER I GRØNLAND

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TIL GRØNLANDS NORDØSTKYST 1906—1908

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BIND III

INDHOLD

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I.

LIST OF VASCULAR PLANTS

FROM

NORTH-EAST GREENLAND (N. OF 76° N. LAT.)

COLLECTED BY THE DANMARK-EXPEDITION 1906–1908

BY

C. H. OSTENFELD AND ANDR. LUNDAGER

WITH PL. I—VI

1910

INTRODUCTION.

The flora of East Greenland north of 76° N. Lat. has hitherto been very little known. The only paper dealing with the flora of that part of Greenland is a short list, compiled by one of us, of the few plants gathered by Mr. E. KOEFOED during the Oceanographic Expedition of the Duke of Orleans in 1905 (see the list of literature, p. 5).

On the other hand, the flora of the north of East Greenland, south of 76° N. Lat., is well known through the researches of SCORESBY, JUN., E. SABINE, CLAVERING and PANSCH, N. HARTZ, A. G. NATHORST, P. DUSÉN, C. KRUUSE, etc. Mr. C. KRUUSE has compiled a list of all the data concerning the flora of East Greenland between 75° and 66° 20′ N. Lat., and in this paper that list will be quoted under each species, provided that the species occurs therein.

On comparing our list with that of KRUUSE it appears that only one species is quite new to the flora of East Greenland, viz. *Alsine Rossii*, which is new to the flora of the whole of Greenland. Another species, *Draba subcapitata* Simm., has not previously been recorded from East Greenland, but specimens of it are contained in KRUUSE's collection under other names.

Our list contains 92 species, which is a rather poor number, but several more species will undoubtedly be found by further investigations.

The material collected originates mostly from the district around Danmarks Havn (Harbour), 76° 46′ N. Lat. and 18° 43′ W. Long., on Germania Land. The area thoroughly investigated extends from 76° 43′ N. Lat. to 77° N. Lat. and from 17° 30′ W. Long. to 21° W. Long. From outside this area small collections have been brought home from different points along the coast northwards to Hyde Fjord on Peary Land and from some places more landward, especially from Ymers Nunatak in the land-ice.

The greater part of the material has been collected by one of the authors, A. LUNDAGER, but we are indebted to the sledge-expedi-

tion of Captain J. P. Koch in the spring of 1907 for the few plants (19 species) collected along the coast northwards, to another sledge expedition over the land-ice for the species (26) from Ymers Nunatak and Kulhøj, and to different members of the expedition for scattered specimens from different places, e. g. to Mr. P. Freuchen for *Pedicularis flammea* and *Carex incurva* from Rypefjeld.

The collecting places, arranged from north to south, are given under each species: —

Peary Land, Fr. Hyde Fjord ...	83°	15′	N. Lat.					
Mallemukfjeld	80°	10′	-	-				
Lamberts Land	79°	8′	-	-				
Bjørneskær	ca. 77°	30′	-	-				
Cape St. Jacques	77°	36′	-	-	18°	05′	W.	Long.
Cape Amélie	77°	32′	-	-	19°	15′	-	-
Cape Marie Valdemar	ca. 77°	20′	-	-	18°	50′	-	-
Ymers Nunatak	77°	24′	-	-	24°		-	-
Germania Land: —[1]								
Kulhøj, Valley between Annexsø and Sælsø, Fuglenæbsfjeld, Rypefjeld, Bastionen, Hvalrosodde, Dove Bugt, Moskusoksefjelde, Lille Snenæs, Snenæs, Stormkap, Harefjeld, Danmarks Havn, Basiskær, Termometerfjeld, Cape Bismarck	Between 77° — 76° 43′ N. Lat. and 21° — 17° 30′ W. Long.							
Maroussia Island	76°	39′	N. Lat.		18°	43′	W.	Long.
St. Koldewey Island	ca. 76°	30′	-	-	18°	50′	-	-

The three places whence Mr. Koefoed of the Duke of Orleans Expedition brought plants home are Cape St. Jacques (Ile de France), Cape Bismarck and Maroussia Island; they are inserted in the list

[1] The localities given here have been arranged from NW. to SE.

of localities above, and in the enumeration they are mentioned under the species recorded in the list of Mr. Koefoed's plants.

We have divided the work between us in the following manner: Mr. A. Lundager undertook the provisional determination of most of the plants, and has added the localities, the time of flowering and the other biological notes. Dr. C. H. Ostenfeld has finally determined the whole material and is responsible for the correctness of the determination, has written the synonymy, and has added the systematical notes.

The dates concerning the time of flowering indicate the first time a species was observed in flower during the years 1907 and 1908.

List of papers dealing with the Vascular Plants of northern East Greenland.

1. Buchenau, F. u. Focke, W. O.: Gefässpflanzen, in Zweite Deutsche Nordpolfahrt, II. 1872.
2. Dusén, P.: Zur Kenntniss der Gefässpflanzen Östgrönlands. — Bih. Sv. Vet. Akad. Handl., Stockholm, Bd. 27. III. 3. 1901.
3. Hartz, N.: Fanerogamer og Karkryptogamer fra Nordöst-Grönland, c. 75° — 70° N. Br. og Angmagsalik, c. 65° 40′ N. Br. — Medd. om Grönland, XVIII. 1896.
4. Hooker, W. J.: List of plants from the east coast of Greenland, in Scoresby, jun. Journ. of a voyage to the northern whale fishery, etc. 1823.
5. Hooker, W. J.: Some account of arctic plants found by Edw. Sabine. — Transact. Linn. Soc., XIV, 1825.
6. Kruuse, C.: List of the phanerogams and vascular cryptogams found on the, coast (75° — 66° 20′ N. Lat.) of East Greenland. — Medd. om Grönland, XXX, 1905.
7. Ostenfeld, C. H.: Plantes récoltées à la côte nord-est du Grönland, in Duc d'Orléans, Croisière océanographique dans la mer du Grönland en 1905. Resultats scientifiques. Bruxelles, 1908.

General works.

Lange, Joh. Conspectus Florae Groenlandicae. — Meddelelser om Grönland, III, Kjøbenhavn. 1880.

Ostenfeld, C. H. Flora Arctica. Part I. Copenhagen 1902.

SYSTEMATICAL LIST OF THE VASCULAR PLANTS.

Polypodiaceae.

Cystopteris Bernh.

1. **Cystopteris fragilis** (L.) Bernh., Vers. Anordn. Farnkr., 1806, p. 27; Gelert, in Ostenfeld, Fl. Arct., I, p. 6.

Kruuse, East Greenland, p. 206.

Loc. Germania Land: Danmarks Havn, and landward.

Note. Owing to the unfavourable nature of the surface this species occurs only very sparingly around Danmarks Havn; but more landward where the higher hills afford more favourable conditions, specimens were found about 25 cm. high.

Woodsia R. Br.

2. **Woodsia glabella** R. Br., in Richardson, App. Franklin Journ., p. 754, 1823; *W. ilvensis*, var. *glabella* Trautv., Acta Horti Petropol., X, 1887, p. 546; Gelert, in Ostenfeld, Fl. Arct., I, 1902, p. 7.

Kruuse, East Greenland, p. 207.

Duc d'Orleans, Cape Bismarck (Ostenfeld, p. 10, 1908).

We think it more convenient to give this *Woodsia* as a separate species, and not as a form of *W. ilvensis* (cf. H. G. Simmons, Sec. arct. exp. Fram, 1898—1902, No. 2, 1906, p. 184). It is an interesting fact that only this species has been found by the Danmark Expedition, and it seems that *W. ilvensis* does not occur as far north, but it has been brought home from the Sabine Island a little to the south, and consequently we are just north of its northern limit.

Loc. Germania Land, in crevices of the cliffs and hidden between stones on open rocky-flats.

Equisetaceae.

Equisetum L.

3. **Equisetum arvense** L. Sp. pl., 1753, p. 1061; Gelert, in Ostenfeld, Fl. Arct., I, 1902, p. 10.

Kruuse, East Greenland, p. 208.

The specimens collected bear simultaneously, in July, both fertile stems with ripe spores, and sterile stems; they may be named f. *riparia* (Fr.) Milde (Monogr. Equiset., tab. 1, figs. 9—10).

Loc. Germania Land: Danmarks Havn.

Note. Is rather rare and occurs always in clayey soil, excepting a single specimen of a peculiar form which was found on "Bastionen" in a sheltered place (June 27th 1908).

4. **Equisetum variegatum** Schleich., Catal. Plant. Helvet., 1807, p. 27; Gelert, in Ostenfeld, Fl. Arct. I, 1902, p. 9.

Kruuse, East Greenland, p. 207.

Small sterile specimens belonging to f. *anceps* Milde (Verhandl. zool. bot. Ges. Wien, XIV, p. 14, 1864) have been collected, but only in one single spot.

Loc. Germania Land: Moskusoksefjeldene in a dried-up tarn on a gravelly hill.

Lycopodiaceae.

Lycopodium L.

5. **Lycopodium selago** L. Sp. pl., 1753, p. 1102; Gelert, in Ostenfeld, Fl. Arct., I, 1902, p. 12.

Kruuse, East Greenland, p. 205.

The specimens collected belong to f. *appressa* Desv.

Loc. Germania Land: Danmarks Havn. Very rare and always in the Cassiope-association; snow-covered during winter.

Liliaceae.

Tofieldia Huds.

6. **Tofieldia coccinea** Richards., App. Franklin Journ., 1823, p. 736; Ostenfeld, Fl. Arct., I, 1902, p. 32.

Kruuse, East Greenland, p. 187.

Seems to be a very rare plant in East Greenland, which is its eastern limit of distribution.

Loc. Germania Land: Dove Bugt.

Flow. July 11th 1908.

Note. Only one specimen was flowering. Snow-covered during the winter.

Juncaceae.

Juncus L.

7. **Juncus castaneus** Sm., Fl. Brit., I, 1800, p. 383; Gelert, in Ostenfeld, Fl. Arct., I, 1902, p. 24.

Kruuse, East Greenland, p. 188.

Loc. Germania Land: below Termometerfjeld at Danmarks Havn, along a little water-course.

Flow. Aug. 31st 07.

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8. **Juncus biglumis** L. Sp. pl., 1753, p. 328; Gelert, in Ostenfeld, Fl. Arct., I, 1902, p. 25.

Kruuse, East Greenland, p. 187.

Loc. Ymers Nunatak; Germania Land, rather common; St. Koldewey.
Flow. June 27th 08.
Note. Is the most common Juncus-species within the area.

9. **Juncus triglumis** L. Sp. pl. 1753, p. 328; Gelert in Ostenfeld, Fl. Arct., 1902, p. 25.

Kruuse, East Greenland, p. 188.

Only collected in two localities. The specimens must be referred to the chestnut-coloured form: f. *Copelandi* Buchenau (Zweite Deutsche Nordpolarfahrt, 1869—70, Botanik, p. 51).

Loc. Germania Land: Danmarks Havn.
Flow. July 15th 08.
Note. It grows in humid places, e. g. in hollows with stagnant water. Associated with Carex pulla and Arctagrostis latifolia.

Luzula D. C.

10. **Luzula arcuata** (Wahlenb.) Sw., var. **confusa** Lindeb., in Botan. Notis., Lund, 1855, p. 9; Gelert, in Ostenfeld, Fl. Arct., I, p. 29.

Kruuse, East Greenland, p. 189.
Duc d'Orleans, Cape Bismarck (Ostenfeld, 1908, p. 9).

The rich material collected shows that the plant is rather variable; some of the specimens approach the principal form, *L. arcuata* (Wb.) Sw., which has not been found in Greenland.

Loc. Lambert Land; Cape St. Jaques; Ymers Nunatak; Cape Marie Valdemar; Germania Land: common around Danmarks Havn.
Flow. Beginning of July.

11. **Luzula nivalis** (Læstad.) Beurlin, in Botan. Notiser, Lund, 1853, p. 55; Gelert, in Ostenfeld, Fl. Arct., I, 1902, p. 30.

Kruuse, East Greenland, p. 190.
Duc d'Orleans, Cape St. Jacques (Ostenfeld, 1908, p. 9).

Loc. Cape Marie Valdemar; Germania Land: Stormkap, not common; St. Koldewey.

Cyperaceae.

Eriophorum L.

12. **Eriophorum Scheuchzeri** Hoppe, Bot. Taschenb., 1800, p. 104, App. t. 7; Ostenfeld, Fl. Arct. I, 1902, p. 41; Fernald, in Rhodora, 7, 1905, p. 82.

Kruuse, East Greenland, p. 190.

Loc. Germania Land, common. It forms associations at the margins of tarns and pools.

13. **Eriophorum polystachyum** L., Sp. pl., 1753, p. 52; Ostenfeld, Fl. Arct., I, 1902, p. 53; Fernald, Rhodora, 7, 1905, p. 88.

Kruuse, East Greenland, p. 191.

The specimens collected all belong to the high-arctic (and high-alpine) form: f. *elegans* Bab. (Man., 1843, p. 333; cf. Fernald, l. c., p. 89).

Loc. Germania Land, very common.

Flow. At the end of June.

Note. A prominent species which occurs everywhere, when there are gently-sloping sandy surfaces and water flowing from snow-drifts.

Cobresia Willd.

14. **Cobresia Bellardii** (All.) Degland., in Loisel., Fl. gall., II, 1807, p. 626; Kükenthal, Caricoideae, in Das Pflanzenreich, 1909, p. 37; *Elyna Bellardi* (All.) K. Koch, in Linnæa 1848, p. 616; Ostenfeld, Fl. Arct., I, 1902, p. 44.

Kruuse, East Greenland, p. 191.

Loc. Germania Land: Danmarks Havn, rather common.

Flow. Latter half of June.

Note. In exposed places it forms dense tufts like those of Carex nardina; there it is often snowless during winter and distinctly wind-affected. In more sheltered places which are snow-covered during winter and rather wet during summer, it forms grass-sward in association with Carex rupestris.

15. **Cobresia bipartita** (All.) Dalla Torre, Anleit. Best. Alpenpfl., 1882, p. 330; Ostenfeld, Fl. Arct., I, 1902, p. 44; *C. caricina* Willd.; Kükenthal, Caricoideae, in Das Pflanzenreich, 1909, p. 45.

Kruuse, East Greenland, p. 191.

Loc. Germania Land, in the depression W. of Termometerfjeld at Danmarks Havn; only one tuft found.

Carex L.

16. **Carex nardina** Fries, Mantissa II, 1839, p. 55; Kükenthal, Caricoideae, in Das Pflanzenreich, 1909, p. 70; Ostenfeld, Fl. Arct. I, 1902, p. 48.

Kruuse, East Greenland, 1905, p. 191.

Loc. Ymers Nunatak; Cape Marie Valdemar; Germania Land: Danmarks Havn, very common.

Flow. End of June.

Note. Often snowless during winter.

17. **Carex rupestris** All., Fl. pedemont., II, 1785, p. 264, tab. 92, fig. 1; Kükenthal, Caricoideae, in Das Pflanzenreich, 1909, p. 86; Ostenfeld, Fl. Arct., I, 1902, p. 86.

Kruuse, East Greenland, 1905, p. 192.

Loc. Germania Land: Danmarks Havn, Snenæs, not common.
Flow. June 25th 08.
Note. Prefers sheltered localities, snow-covered during winter.

18. **Carex incurva** Lightf., Fl. scotic. II, 1777, p. 544, tab. 24; Kükenthal, Caricoideae, in Das Pflanzenreich, 1909, p. 113; Ostenfeld, Fl. Arct., I, 1902, p. 49.

Kruuse, East Greenland, p. 193.

The specimens collected belong to the f. *erecta* O. F. Lang (Linnæa, 24, 1851, p. 507) with stiff and erect culms.

Loc. Germania Land: found only at Rypefjeld.

19. **Carex rigida** Good. in Transact. Linn. Soc. II, 1794, p. 193, tab. 22; Kükenthal, Caricoideae, in Das Pflanzenreich, 1909, p. 299; Ostenfeld, Fl. Arct., I, 1902, p. 77.

Kruuse, East Greenland, 1905, p. 195.

The specimens collected at Rypefjeld are in several respects different from the type and resemble *C. aquatilis*, var. *stans*; but the anatomy of the leaves corresponds better with that of *C. rigida*, although the papillae on the under side of the leaves are very slightly developed, not so conspicuous as in typical *C. rigida*. The terminal spikelet bears female flowers in its lower part.

Also the specimens from Moskusoksefjelde bear some resemblance to *C. aquatilis*, var. *stans*.

Loc. Germania Land: Rypefjeld, Moskusoksefjelde, Lille Snenæs.
Flow. Beginning of July.

20. **Carex salina** Whbg., var. **subspathacea** (Wormskj.) Tuckerm., Enum. Method., 1843, p. 12; Ostenfeld, Fl. Arct., I, 1902, p. 73; *C. subspathacea* Wormskj., Fl. dan., 1816, tab. 1530; Kükenthal, Caricoideae, in Das Pflanzenreich, 1909, p. 361.

Kruuse, East Greenland, p. 194.

Loc. Germania Land: Danmarks Havn in only one place, viz. Basiskær, among damp moss and together with Pleuropogon.
Flow. July 17th 07.

21. **Carex misandra** R. Br., Chloris Melvill., 1823, p. 25; Ostenfeld, Fl. Arct., I, 1902, p. 89; *C. fuliginosa*, *β*, *misandra* (R. Br.) O. F. Lang; Kükenthal, Caricoideae, in Das Pflanzenreich, 1909, p. 557.

Kruuse, East Greenland, p. 194.

In the typical specimens the colour of the scales of the female spikelets is very dark, nearly black ("*atrofusca*"), but in a single series of specimens from Danmarks Havn it is light brown (pale chestnut-brown); this form (f. *ochrolochin* Ostf., nov. forma) corresponds with f. *ochrostachys* Schur of the true *C. fuliginosa* Schkuhr (cf. Kükenthal, l. c.); it has been mentioned by W. J. Hooker (Bot.

Append. Parry 2nd. voy., 1825, p. 406) under the name *C. fuliginosa, β, squamis capsulisque pallide fuscis.*

Loc. Bjørneskær; Germania Land, common; St. Koldewey.
Flow. June 25th 08.
Note. The most common of all the sedges in the area investigated.

22. **Carex pulla** Good., Transact. Linn. Soc., III, 1797, p. 78, tab. 14; Ostenfeld, Fl. Arct., I, 1902, p. 95; *C. vesicaria*, subsp. *saxatilis* (L.) Almq.; Kükenthal, Caricoideae, in Das Pflanzenreich, 1909, p. 727.

Kruuse, East Greenland, p. 196.

Loc. Germania Land: Danmarks Havn and landward around Dove Bugt.
Flow. End of July.
Note. The most common sedge in the bog, grows together with Eriophorum polystachyum; very conspicuous on account of its fresh-green colour.

Gramineae.

Hierochloë Gmel.

23. **Hierochloë alpina** (Liljebl.) Roem. & Schult., Syst. Veget., vol. 2, 1817, p. 515; Gelert, in Ostenfeld, Fl. Arct., I, 1902, p. 97; *Savastana alpina* Scribn., Mem. Torr. Bot. Club, V, 1894, p. 34.

Kruuse, East Greenland, p. 197.

Loc. Germania Land, common everywhere.
Flow. June 16th 07; June 24th 08.
Note. High and vigorous tufts often mark the burrows of the lemmings and show at a distance where such are to be found.

Alopecurus L.

24. **Alopecurus alpinus** Sm., Engl. Bot., 1802, tab. 1126; Fl. Brit., III, 1804, p. 1386; Gelert, in Ostenfeld, Fl. Arct., I, 1902, p. 99.

Kruuse, East Greenland, p. 196.
Duc d'Orleans, Cape St. Jacques (Ostenfeld, 1908, p. 9).

All the specimens collected belong to the f. *mutica* Sommerf., with awns not projecting beyond the pales.

Loc. Lambert Land; Bjørneskærene; Germania Land, very common.
Flow. June 22nd 07.

Aira L.

25 a. **Aira caespitosa** L., var. **arctica** (Trin.) Simmons, Rep. Arct. Exp. Fram, 1898—1902, No. 2, 1906, p. 173; *A. arctica* Trinius; *A. brevifolia* (R. Br.) Lange, Consp. Fl. Groenl., 1880, p. 163; *Deschampsia brevifolia* R. Br., Chloris Melvill., 1823, p. 33.

Kruuse, East Greenland, p. 198.

In his memoir on the Ellesmere Land flora Dr. H. G. Simmons has fully elucidated the synonymy of the high-arctic *Aira*, which R. Brown has named *A. brevifolia.*

BIOLOGICAL LA

The material of *Aira* brought home by the Danmark Expedition is very interesting in many points. Some of the numbers (1283, 1287, 1609, 1620) answer well to *A. caespitosa*, var. *arctica* as H. G. Simmons regards it, and must bear that name. It is a low, but rather coarse plant, with short, often somewhat involute leaves, and coarse more or less inflated sheaths, those of the culms bearing sometimes very short blades, sometimes almost none (see Pl. I and Pl. II, fig. 1).

Trinius (Sp. Gram. icon. et descript., III, 1836, Petropolis, Pl. 256, A et B) has given very good figures of this plant, and his analysis of the spikelet (Pl. 256, 1—3) is also correct. The glumes are shorter than or nearly as long as the spikelet, with tips bitten off; awns about as long as the pales.

Besides this variety the Danmark Expedition has collected another still more aberrant form of the *caespitosa*-group which must be referred to: —

25 b. **A. caespitosa** L. var. **pumila** Ledeb., Fl. Ross., IV, 1853, p. 422; *A. brevifolia* Nathorst, Öfv. K. Sv. Vet. Akad. Förh., 1884, p. 27; *A. flexuosa*, var., Simmons, l. c., 1906, p. 175, et ibid., No. 16, 1909, p. 105.

Trinius (l. c., Pl. 256, C) has given a description and a rather good illustration of it, based upon a specimen from Kamtchatka, and Simmons (l. c.) describes its habit and characters very well.

Trinius's description runs as follows: — Fig. C plantulam depingit pumilam, caespites densissimos formantem, panicula parva, angusta, foliis angustissimis, nunc planiusculis nunc fere capillaceo-involutis, brevissimisque insignem, spiculis vero omnino cum A. caespitosa communi congruentem.

It forms dense mats or tufts with numerous very thin, often involute and setaceous leaves, which are much softer than those of var. *arctica*; the culms are low, but generally longer than the leaves; the culm leaves are almost without blade, and with large sheaths (see Pl. II, fig. 2 and Pl. III). The branches of the panicle are thin and usually not so contracted as in var. *arctica*. The glumes are long and acute, as long as or nearly as long as the spikelet, not white-membraneous in the margins; awns about as long as the pales, straight or slightly twisted.

In many of its characters it comes near *A. flexuosa* L., but I cannot follow Simmons when he regards it as a form of that species; the characters of the spikelet, especially of the awns makes it a necessity to refer it to the *caespitosa*-group, and I follow Ledebour and Trinius in this point. It appears always to grow along the margins of ponds or of tarns, and perhaps some of its peculiar characters are adaptations to the habitat.

It is known, moreover from N. E. Greenland, from N. W. Greenland[1] (Ivsugigsok, A. G. Nathorst), Ellesmereland (Fram Harbour, H. G. Simmons) and Kamtchatka (Trinius), while the var. *arctica* is more widely distributed over the whole Arctic region.

Loc. Germania Land: Danmarks Havn, rather common.

Note. It grows in clayey and wet soil at the margins of tarns which dry up during summer, develops late, and is not seen in flower before August.

Phippsia R. Br.

26. **Phippsia algida** (Soland.) R. Br., Chloris Melvill., 1823, p. 27; Gelert, in Ostenfeld, Fl. Arct., I, 1902, p. 101.

Kruuse, East Greenland, p. 200.

Duc d'Orleans, Cape St. Jacques (Ostenfeld, 1908, p. 9).

Loc. Mallemukfjeldet; Lambert Land; Germania Land, rather common; St. Koldewey.

Flow. June 27th 08.

Note. Grows on flat sandy shores and around small tarns and bogs on rocky-flats.

Arctagrostis Griseb.

27. **Arctagrostis latifolia** (R. Br.) Griseb., in Ledeb., Fl. Ross., IV, 1853, p. 434; Gelert, in Ostenfeld, Fl. Arct., I, 1902, p. 107.

Kruuse, East Greenland, p. 200.

Loc. Germania Land, common.

Flow. July 21st 07.

Note. It flowers rarely and has not been found with ripe seed; often the uppermost part of the panicle begins to wither before the flowering has begun. It grows in bogs and at margins of ponds. Leaves as much as 9·5 mm. broad.

Trisetum Pers.

28. **Trisetum spicatum** (L.) P. Richter, Pl. Europ. I, 1890, p. 59; *T. subspicatum* (L.) P. Beauv.; Gelert in Ostenfeld, Fl. Arct., I, 1902, p. 110.

Kruuse, East Greenland, p. 199.

Loc. Germania Land, rather rare.

Note. Prefers sheltered localities, as also pointed out by H. G. Simmons with regard to individuals occurring in Ellesmere Land; snow-covered during winter.

Pleuropogon R. Br.

29. **Pleuropogon Sabinei** R. Br., Chloris Melvill., 1823, p. 31, tab. D; Gelert, in Ostenfeld, Fl. Arct., I, 1902, p. 116.

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[1] To this variety I refer also a very interesting *Aira* collected in West Greenland on the Island of Disco (N. W. coast, Giesecke's valley, 1902, Nr. 307) by M. P. Porsild. It is much higher than the true var. *pumila* (culms 20—30 cm. high), but has the setaceous leaves in common with it, also the characters of the spikelets agree with it. In habit it comes very near *A. setacea* Huds. (*A. discolor* Thuill.; *A. uliginosa* Weihe).

Kruuse, East Greenland, p. 199.

Loc. Germania Land, rather common in coast regions and landward. Flow. July 17th 07.

Note. It occurs both as f. *terrestris* Simm. and f. *aquatica* Simm. with leaves more than 20 cm. long. (cf. H. G. Simmons, Rep. Sec. Nom. Arct. Exp. Fram, 1898—1902, No. 2, 1906, p. 170). Is a very conspicuous and characteristic plant in bogs and swamps.

Glyceria R. Br.

30. **Glyceria angustata** (R. Br.) E. Fries, Mantissa III, 1842, p. 176; Gelert in Ostenfeld, Fl. Arct., I, 1902, p. 128.

Kruuse, East Greenland, p. 202.

The whole of the rich material of *Glyceria* (the following species excepted) must be referred to *Gl. angustata*, although it varies greatly in many respects, e. g. in the shape of the panicle, the flat or convolute leaves. Quite another question is, whether it is possible to draw a boundary line between this species and *G. distans* (L.) Wahlenb. in its arctic aspect.

Loc. Hyde Fjord in Peary Land; Mallemukfjeld; Kulhøj (the only occurring plant on the moraine toward the border of the ice); Germania Land, common.

Note. Occurs often in beds of water-courses, but most frequently in wet clayey soil, where the tufts spread themselves, and the culms and leaves occur closely pressed to the bottom.

31. **Glyceria maritima** (Huds.) Wahlenb., f. **reptans** (Hartm.) Simmons, Rep. Sec. Arct. Exp. Fram, 1898—1902, No. 2, 1906, p. 159; *G. mar.* f. *vilfoidea* (Anderss.) Gelert, in Ostenfeld, Fl. Arct., I, 1902, p. 126.

Kruuse, East Greenland, p. 201.

Loc. Germania Land, rather common.

Note. Grows on low, flat sea-shores and forms occasionally a nearly coherent grass-sward. Only found sterile.

Poa L.

32. **Poa pratensis** L., f. **colpodea** (Th. Fries) Gelert, in Ostenfeld, Fl. Arct. I, 1902, p. 122.

Kruuse, East Greenland, p. 204.

The few specimens collected bear viviparous spikelets in a contracted panicle and agree well with Spitzbergen specimens named *P. colpodea* Th. Fr. (Öfv. K. Sv. Vet. Förh., Stockholm, 1869, p. 138) by Th. Fries himself.

Loc. Germania Land: Hvalrosodde.

33. **Poa cenisia** All., Auct. Fl. Pedem., 1789, p. 40; Gelert, in Ostenfeld, Fl. Arct., I, 1902, p. 122.

Kruuse, East Greenland, p. 204.
Duc d'Orleans, Cape Bismarck (Ostenfeld, 1908, p. 9).

As usual, this species is rather variable. The tufted form occurs among others.

Loc. Cape Saint-Jacques; Cape Marie Valdemar; Germania Land: Danmarks Havn; St. Koldewey.

34. **Poa abbreviata** R. Br., Chloris Melvill., 1823, p. 29; Gelert in Ostenfeld, Fl. Arct., I, 1902, p. 124.

Kruuse, East Greenland, p. 202.
Duc d'Orleans, Maroussia Isl. (Ostenfeld, 1908, p. 9).

Rich material of this high-arctic species was brought home. It is evidently a well-defined species, and it is hard to understand how KRUUSE (l. c.) can "look on it as a high-arctic form of *P. laxa*."

Loc. Hyde Fjord in Peary Land; Mallemukfjeld; Lambert Land; Cape Saint-Jacques; Ymers Nunatak; Germania Land: Danmarks Havn, common everywhere; St. Koldewey.

35. **Poa glauca** M. Vahl, Flora dan., 1790, fasc. 17, p. 3, tab. 964; Gelert, in Ostenfeld, Fl. Arct., I, 1902, p. 124; *P. caesia* Sm., Fl. Brit., I, 1800, p. 103.

Kruuse, East Greenland, p. 203.

Loc. Ymers Nunatak; Germania Land: Dove Bugt, Lille Snenæs, Danmarks Havn.

Festuca L.

36. **Festuca ovina** L., subsp. **brevifolia** (R. Br.) Hackel, Botan. Centralbl., 1881, p. 406; Gelert, in Ostenfeld, Fl. Arct., I, p. 130, 1902.

Kruuse, East Greenland, p. 204.
Duc d'Orleans, Cape St. Jacques (Ostenfeld, 1908, p. 10).

I think it is allowable to refer all the specimens to subsp. *brevifolia* (R. Br.) Hack., but I must admit that I have not been able to find any definite distinguishing character between this form and subsp. *supina* Schur, as it has been defined by Scandinavian authors. In one locality the species was viviparous (dunes at Dove Bugt).

Loc. Germania Land, rather common.

Note. It prefers fairly sheltered places and is usually snow-covered during winter.

Salicaceae.

Salix L.

37. **Salix arctica** Pall., Fl. Ross. II, 1790, p. 86; A. N. Lundström, Weiden Nowaja Semljas, Upsala, 1877, p. 31, fig. 1; *S. groenlandica* (Anders.) Lundstr., l. c., p. 36; Lange. Consp. Fl. Groenl., 1880, p. 108; *S. Brownii* (Anders.) Lundstr., l. c., p. 37.

Kruuse, East Greenland, p. 186.

Duc d'Orleans, Cape St. Jacques, Maroussia Isl. and Cape Bismarck (Ostenfeld, 1908, p. 8).

The material brought home varies greatly with regard to the shape of the leaves. The most common form is var. *Brownii* Anders. with ± broadly obovate leaves, but the extreme form, the broad-leaved, true *S. arctica* Pallas was also found, as well as the narrow-leaved var. *groenlandica* Anders.

Loc. Hyde Fjord (var. Brownii); Mallemukfjeld; Bjørneskær; Cape Marie Valdemar; Germania Land: Danmarks Havn, very common, but always as an "espalier-plant."[1]

Flow. Middle of June.

38. **Salix herbacea** L. Sp. pl. 1753, p. 1018; Lange, Consp. Fl. Groenl., 1880, p. 106.

Kruuse, East Greenland, p. 186.

Loc. Germania Land: Danmarks Havn, in one place.

Flow. July 3rd 08.

Note. Was found in a boggy moor together with Empetrum and Cassiope; only female specimens were observed.

Polygonaceae.

Polygonum L.

39. **Polygonum viviparum** L. Sp. pl. 1753, p. 360; Lange, Consp. Fl. Groenl., p. 105, 1880.

Kruuse, East Greenland, p. 185.

Duc d'Orleans, Cape Bismarck (Ostenfeld, 1908, p. 8).

This species has been collected only around Danmarks Havn. Two forms occur: —

(1) a form with both bulbils and flowers, and with hairs on the under side of the leaves

(2) a form with bulbils only, and with leaves glabrous on the under side.

Loc. Germania Land, rather common.

Flow. July 7th 08.

Oxyria Hill.

40. **Oxyria digyna** (L.) Hill, Hort. Kew., 1768; Lange, Consp. Fl. Groenl., 1860, p. 105.

Kruuse, East Greenland, p. 185.

Duc d'Orleans, Cape Bismarck (Ostenfeld, 1908, p. 8).

Loc. Germania Land, common everywhere.

[1] Warming's term for plants with prostrate, outspread growth.

Caryophyllaceae.

Melandrium Röhl.

41. **Melandrium apetalum** (L.) Fenzl, in Ledeb., Fl. Ross., I, 1842, p. 326; Lange, Consp. Fl. Groenl., 1880, p. 19.

Kruuse, East Greenland, p. 154.

The specimens collected belong to f. *arctica* Th. Fries (Öfv. K. Sv. Vet. Akad. Förh., 1869, p. 133) with petals projecting beyond the calyx.

Loc. Bjørneskærene; Germania Land, rather common.

Flow. June 29th 08.

Note. Grows by preference in humid places near lake-margins or running water; snow-covered during winter.

42. **Melandrium affine** J. Vahl, Fl. dan., fasc. 40, 1843, p. 5; *M. involucratum* (Cham. & Schltd), *β, affine* Rohrb.; Lange, Consp. Fl. Groenl., 1880, p. 20.

Kruuse, East Greenland, p. 154.

Duc d'Orleans, Cape Bismarck (Ostenfeld, 1908, p. 5).

This species appears always to be easily distinguishable from *M. apetalum* and *M. triflorum*, and its white petals and more or less white calyx (with dark veins and teeth) are very characteristic.

Loc. Germania Land, rather common.

Flow. Beginning of July.

43. **Melandrium triflorum** (R. Br.) J. Vahl, Fl. Dan., fasc. 40, 1843, p. 5, tab. 2356; Lange, Consp. Fl. Groenl., 1880, p. 20.

Kruuse, East Greenland, p. 154.

Petals mostly pink or rose-coloured; calyx with a dense covering of long glandular hairs.

Loc. Germania Land, common; Maroussia Isl.

Flow. June 22nd 08.

Note. Grows on rocky-flats where high, vigorous specimens mark the burrows of lemmings.

Silene L.

44. **Silene acaulis** L. Sp. pl., ed. 2, vol. I, 1762, p. 603; Lange, Consp. Fl. Groenl., 1880, p. 19.

Kruuse, East Greenland, p. 153.

Loc. Germania Land, common everywhere.

Flow. July 3rd 07; June 24th 08.

Arenaria L. (ex pte).

45. **Arenaria ciliata** L., var. **humifusa** (Wahlenb.) Hartm. Handb. Skand. Flora, ed. 11, p. 243, 1879; Lange, Consp. Fl. Groenl., 1880, p. 27.

Kruuse, East Greenland, p. 157.

Loc. Germania Land, common.

Flow. June 29th 08.

Note. Grows on gravelly, rather flat ground near the shore. It forms dense and large tufts with numerous flowers which attract the observer by their snow-white colour and by their strong odour, — so rare in arctic regions.

Alsine Wahlenb.

46. **Alsine verna** (L.) Wahlenb., Fl. Lappon., 1812, p. 128; Lange, Consp. Fl. Groenl., 1880, p. 24.

Kruuse, East Greenland, p. 156.

Most of the specimens collected may be referred to f. *rubella* Wahlenb. (l. c., p. 128, pro sp.), but the forms seem to be indistinguishable.

Loc. Ymers Nunatak; Germania Land, rather common on table-lands; snow-covered during winter.

Flow. June 21st 08.

47. **Alsine biflora** (L.) Wahlenb., Fl. Lapp. 1812, p. 128; Lange, Consp. Fl. Groenl., 1880, p. 23.

Kruuse, East Greenland, p. 155.

Loc. Germania Land: Danmarks Havn, in only one place.

Flow. July 17th 08; no flowers in 1907.

Note. It was found on a sheltered, humid slope facing south, near the sea-shore.

48. **Alsine Rossii** (R. Br.) Fenzl, Verbr. d. Alsin., Wien, 1833, p. 18; Lange, Consp. Fl. Groenl., 1880, p. 25; Simmons, Medd. Grönl., vol. 26, 1904, p. 470; Simmons, Sec. Arct. Exp. Fram 1898—1902, No. 2, 1906, p. 116, tab. 6, figs. 4—6; *Arenaria Rossii* R. Br., Chloris Melvill., 1823, p. 14.

As Simmons (1904, l. c.) had proved that Taylor's records of *A. Rossii* from West Greenland were improbable, it was a find of great phyto-geographical importance when the Danmark Expedition brought home a specimen of this species from N. E. Greenland, thus giving the first certain record of it as a Greenland plant.

The small bits collected are sterile (see fig. 1), but by comparison with Ellesmere Land specimens not the slightest doubt as to its identification remains.

Loc. Germania Land: Hvalrosodde.

Sagina L.

49. **Sagina intermedia** Fenzl, in Ledeb., Fl. Ross., I, 1842, p. 339; Simmons, Sec. Arct. Exp. Fram 1898—1902, No. 2, 1906, p. 119; *S. nivalis* (Lindbl.) Fries, Mantissa 3, 1842, p. 31 ex pte; Lange, Consp. Fl. Groenl., 1880, p. 22.

Kruuse, East Greenland, p. 155.

Loc. Germania Land, rather rare.

Flow. July 17th 08.

Note. Grows in the black clay at the bottom of dried-up tarns and also near the shore, when the ground has been covered with snow till late in the summer.

Stellaria L.

50. **Stellaria humifusa** Rottböll, Kiöbenhavn, Selsk. Skrifter, Deel 10, 1770, p. 447, tab. 4, fig. 14.

Kruuse, East Greenland, p. 157.

Loc. Germania Land, common everywhere near the sea-shore.

Flow. Middle of July.

Fig. 1. *Alsine Rossii* (R. Br.) Fenzl. ($^2/_1$ nat. size).

51. **Stellaria longipes** Goldie, Edinb. Philos. Journ. 6, 1822, p. 327; Lange, Consp. Fl. Groenl., 1880, p. 29.

Kruuse, East Greenland, 1905, p. 157.

Duc d'Orleans, Cape St. Jacques and Cape Bismarck (Ostenfeld, 1908, p. 6).

Loc. Hyde Fjord (Peary Land); Bjørneskær (f. humilis Fnzl.); Cape Marie Valdemar, Germania Land: Kulhøj, Danmarks Havn, common everywhere; St. Koldewey.

Flow. July 10th 07.

Cerastium L.

52. **Cerastium alpinum** L. Sp. pl. 1753, p. 628; Lange, Consp. Fl. Groenl., 1880, p. 31.

Kruuse, East Greenland, p. 158.

Duc d'Orleans, Cape St. Jacques, Maroussia Isl. and Cape Bismarck (Ostenfeld, 1908, p. 6).

Numerous quite typical specimens (some of them very hairy) were collected.

Besides the principal form the curious sterile glabrous, small-leaved, densely cæspitose form which Simmons (Sec. Arc. Exp. Fram 1898—1902, No. 2, 1906, p. 122) has named f. *pulvinata* Simm., and which has erroneously been taken for *C. Edmondstonii*, var. *caespitosum* Malmgr. (cf. Kruuse, l. c., p. 159) was found around Danmarks Havn.

Loc. Mallemukfjeld; Bjørneskær; Ymers Nunatak; Germania Land: valley between Annexsø and Sælsø; Danmarks Havn, common everywhere; St. Koldewey.

Flow. June 20th 07; June 21st 08.

Note. In low-lying, humid soil it occurs as large tufts with decumbent flowering stems, pressed close to the ground. When the flowering plant in the autumn is suddenly covered with snow which remains during the winter, all the parts of it are so well preserved, that in the spring when the snow has melted, they appear again and apparently are as fresh as if they had quite recently unfolded themselves.

Ranunculaceae.

Ranunculus L.

53. **Ranunculus glacialis** L. Sp. pl., 1753, p. 553; Lange, Consp. Fl. Groenl., 1880, p. 54.

Kruuse, East Greenland, p. 167.

Loc. Germania Land, common.

Flow. June 22nd 07, June 18th 08.

Note. Around small ponds where the snow has melted early, it is one of the spring flowers. On the other hand, where the snow-drifts are perennial and irrigate the lower-lying, evenly sloping ground, it follows the drifts as they melt and flowers here till the frost begins towards the end of August or in the beginning of September.

54. **Ranunculus sulphureus** Soland. in Phipps, Voy. N. Pole, London 1774, p. 202; *R. altaicus* Laxman; Lange, Consp. Fl. Groenl., 1880, p. 56.

Kruuse, East Greenland, p. 168.

Duc d'Orleans, Cape St. Jacques (Ostenfeld, 1908, p. 6).

The Expedition has brought home very rich material of this species, while *R. nivalis* L., which has been recorded as far north as Little Pendulum Isl., is completely absent from the collection.

Loc. Bjørneskærene; Germania Land: Danmarks Havn, common.

Flow. June 18th 07, June 15th 08.

55. **Ranunculus pygmaeus** Wahlenb., Fl. Lappon., 1812, p. 157; Lange, Consp. Fl. Groenl., 1880, p. 55.

Kruuse, East Greenland, p. 167.

Loc. Germania Land: Danmarks Havn, rather common.

Flow. July 9th 08.

Note. Prefers sheltered localities with clayey soil.

56. **Ranunculus hyperboreus** Rottböll, Kiöbenhavn, Selsk. Skrifter, Deel 10, 1770, p. 458, tab. 4, fig. 16; Lange, Consp. Fl. Groenl., p. 55, 1880.

Kruuse, East Greenland, p. 168.

In Maroussia Isl. typical specimens were collected in fairly large quantities, and a single specimen occurred from Danmarks Havn.

At the border of a small tarn near Danmarks Havn a curious

Fig. 2. *Ranunculus hyperboreus* Rottb., var. (Nat. size).

little form (fig. 2) was found among moss. At first sight it greatly recalls *R. pygmaeus* Whb. The stem is much shorter than is usual in *R. hyperboreus* and has only 1—2 rooting nodes, or is, in smaller specimens, not at all creeping; the leaf-blades are deeply 3—5-lobed and the lobes are broadly linear or oblong. Perhaps it is a hybrid between the two species.

Loc. Germania Land: Danmarks Havn; Maroussia Isl.
Flow. July 21st 08.

Papaveraceae.

Papaver L.

57. **Papaver radicatum** Rottböll, Kiöbenhavn, Selsk. Skrifter, Deel 10, 1770, p. 455, tab. 8, fig. 24; *Papaver nudicaule*, Lange, Consp. Fl. Groenl., 1880, p. 52.

Kruuse, East Greenland, p. 166.

Duc d'Orleans, Cape St. Jacques, Maroussia Isl. and Cape Bismarck (Ostenfeld, 1908, p. 6).

Often with white petals (f. *albiflora*, Lange, l. c.).

Loc. Hyde Fjord (Peary Land); Mallemukfjeld; Lambert Land; Bjørneskær; Ymers Nunatak; Cape Marie Valdemar, Germania Land: Danmarks Havn, very common.

Flow. June 27th 07, June 20th 08.

Cruciferae.

Cochlearia L.

58. **Cochlearia officinalis** L., var. **groenlandica** (L.) Gelert, in Andersson & Hesselman, Bih. Sv. Vet. Akad. Handl., 26, III, No. 1, 1900, p. 37; *C. groenlandica* (ex pte) et *C. fenestrata*, Lange, Consp. Fl. Groenl., 1880, pp. 34—36.

Kruuse, East Greenland, p. 160.

The material collected belongs to var. *groenlandica* as defined by Gelert (l. c.) and a part of it to its form f. *minor* (Lge.) Gelert.

Loc. Germania Land: Danmarks Havn, common.

Flow. June 23rd 08.

Note. It thrives very well, sheltered by the stones on a level sea-shore. In late summer it is often found landward in dried-up water-courses, and then as f. *minor*.

Eutrema R. Br.

59. **Eutrema Edwardsii** R. Br., Chloris Melvill., 1823, p. 9, tab. A; Lange, Consp. Fl. Groenl., 1880, p. 46.

Kruuse, East Greenland, p. 164.

Collected in two places, but only one specimen gathered in each place.

Loc. Germania Land: Danmarks Havn.

Flow. July 9th 07.

Cardamine L.

60. **Cardamine pratensis** L. Sp. pl., 1753, p. 656; Lange, Consp. Fl. Groenl., 1880, p. 48.

Kruuse, East Greenland, p. 165.

Loc. Germania Land: Danmarks Havn.

Note. Only found in two places. A single specimen was found in flower in Aug. 1907, but no fruit-setting was observed when the frost began on Aug. 25th.

61. **Cardamine bellidifolia** L. Sp. pl., 1753, p. 654; Lange, Consp. Fl. Groenl., 1880, p. 47.

Kruuse, East Greenland, p. 164.

Duc d'Orleans, Cape St. Jacques (Ostenfeld, 1908, p. 6).

Loc. Germania Land: Danmarks Havn, rather common.

Flow. June 27th 08.

Lesquerella S. Wats.

62. **Lesquerella arctica** (Wormskj.) S. Watson, Proc. Am. Acad. 1888, vol. 23, p. 254; *Alyssum arcticum* Wormskj., Fl. Dan., fasc. 26, 1818, p. 3, tab. 1520; *Vesicaria arctica* Richards.; Lange, Consp. Fl. Groenl., 1880, p. 34.

Kruuse, East Greenland, p. 159.

Loc. Germania Land: valley between Annexsø and Sælsø, Hvalrosodde, Dove Bugt, Snenæs, Stormkap.

Flow. June 22nd 08.

Note. Members of this species were not found around Danmarks Havn, excepting one specimen from Harefjeld. Further landward from Stormkap to Dove Bugt very common in dry, gravelly soil, usually as isolated specimens. But it was found here and there in tufts of grasses and thrives well in such conditions, at least the leaves become larger. Only once found in an association of *Cassiope*. It has the same distribution as *Potentilla pulchella*, and like this species it develops into a peculiar "pillar-form" (fig. 3) when growing on the wind-side of gravelly slopes, where it is snowless in winter. The "pillar" consists of freely projecting stems covered with old, wind-blown remains of leaves, and at the top a small rosette of green leaves which protect the buds during winter.

Fig. 3. *Lesquerella arctica* (Wormskj.) S. Wats., "pillar." (1½ nat. size).

Draba L.

63 a. **Draba hirta** L. Sp. pl. ed. 2, vol. II, 1763, p. 897; Lange, Consp. Fl. Groenl., 1880, p. 42.

Kruuse, East Greenland, p. 163.

The true *D. hirta* seems to be very rare in the area investigated,

only some few and young specimens have been referred to it. It is replaced by the following variety.

Loc. Germania Land: Danmarks Havn, Snenæs.

Flow. June 29th 07.

Note. At Snenæs well developed specimens were found near the burrow of a lemming; the 25 cm. high, year-old stems had borne fruit abundantly, but now on June 25th 08 the flower-buds were not open.

63 b. **Draba hirta** L., var. **arctica** (J. Vahl), S. Watson, Proc. Am. Acad. Sc., vol. 23, 1888; *D. arctica* J. Vahl, Fl. Dan., fasc. 39, 1840, p. 5, tab. 2294; Lange, Consp. Fl. Groenl., 1880, p. 43.

Kruuse, East Greenland, p. 163.

Very common in the area and varies greatly, but is never as high as the authentic specimens from West Greenland.

Loc. Ymers Nunatak; Germania Land: Hvalrosodde, Dove Bugt, Danmarks Havn.

Flow. June 16th 07; June 13th 08.

Note. It grows in gravelly and stony places, often in sheltered depressions with rich grass.

64. **Draba fladnizensis** Wulf, in Jacq. Misc., I, 1778, p. 147; Gelert, in Botan. Tidsskr., 21, 1898, p. 302; *D. Wahlenbergii* et (ex pte) *D. corymbosa*, Lange, Consp. Fl. Groenl., 1880, pp. 40—41.

Kruuse, East Greenland, p. 162 (saltem ex pte).

Duc d'Orleans, Cape Bismarck (Ostenfeld, 1908, p. 6).

Loc. Germania Land: Hvalrosodde, Snenæs, Danmarks Havn.

Flow. June 22nd 07.

65. **Draba subcapitata** Simmons, Sec. Arct. Exp. Fram 1898—1902, No. 2, Kristiania, 1906, p. 87, tab. 1, figs. 3—8.

Kruuse, East Greenland (sub nom. diversis).

This species seems to be rather widely distributed in the area investigated.

We owe to Dr. H. G. Simmons, (l. c.) a clear definition of this badly-treated species, of which no certain record from Greenland has hitherto existed.

Loc. Mallemukfjeldet (?); Ymers Nunatak; Cape Marie Valdemar (?); Germania Land: Lille Snenæs, Danmarks Havn.

Flow. June 22nd 08.

66 a. **Draba alpina** L. Sp. pl. 1753, p. 642; Lange, Consp. Fl. Groenl., 1880, p. 37; Gelert in Bot. Tidsskr., Bd. 21, 1898, p. 299.

Kruuse, East Greenland, pp. 160—161 (incl. D. glacialis).

Duc d'Orleans, Cape St. Jacques (Ostenfeld, 1908, p. 6).

This species is very common in the area investigated and varies greatly. The more distinct forms are: *α, genuina* Lindbl. and *β, hebecarpa* Lindbl., the latter with hairy pods.

The most divergent form is: —

66 b. **D. alpina** L., var. **glacialis** (Adams) Dickie, Journ. Linn. Soc., XI, 1871, p. 33; Simmons, Sec. Arct. Exp. Fram 1898—1902, No. 2, Kristiania, 1906, p. 82.

Loc. Lambert Land (in flower June 14th 07); Ymers Nunatak; Germania Land, common everywhere; St. Koldewey.

Flow. June 16th 07, June 14th 08.

Note. Among the specimens of *Draba* we have found two individuals which, with some hesitation, we have identified as hybrids. They stand between *D. alpina* and *D. fladnizensis*. (No. 1143, Danmarks Havn, 8, VII, 1908; and No. 166, Cape Bismarck, 22, VI, 1907).

Braya Sternb. & Hoppe.

67. **Braya purpurascens** (R. Br.) Bunge, in Ledeb., Fl. Ross., I, 1842, p. 195; Lange, Consp. Fl. Groenl., 1880, p. 46.

Kruuse, East Greenland, p. 163.

In the material collected occur specimens both with stellately hairy, and with glabrous pods (f. *siliculis glabris* Hartz, Medd. Grönl., XVIII, 1895, p. 329 sub *B. glabella*).

Loc. Ymers Nunatak; Germania Land: Hvalrosodde, Dove Bugt, Danmarks Havn.

Flow. And with young fruit June 22nd 08.

Note. Rare around Danmarks Havn, but common more landward around Dove Bugt. It grows in gravelly, dry soil and also in clayey soil in tarns, which have dried up in early summer.

Saxifragaceae.

Saxifraga L.

68. **Saxifraga oppositifolia** L. Sp. pl., 1753, p. 402; Lange, Consp. Fl. Groenl., 1880, p. 66.

Kruuse, East Greenland, p. 173.

Duc d'Orleans, Cape Bismarck and Cape St. Jacques (Ostenfeld, 1908, p. 7).

Loc. Hyde Fjord (Peary Land); Mallemukfjeld; Lambert Land; Bjørneskær (flowering June 19th 07); Cape St. Jacques; Ymers Nunatak; Cape Marie Valdemar; Germania Land: Danmarks Havn, common.

Flow. June 4th 07, June 7th 08.

Note. In some places around Danmarks Havn an unusually large-flowered form was found, the flowers reaching a diameter of 18—23 mm. see Pl. IV).

69. **Saxifraga flagellaris** Willd., in Sternberg, Revis. Saxifr., 1810, p. 25; *S. flag.*, var. *seligera* (Pursh) Engler; Lange, Consp. Fl. Groenl., 1880, p. 65.

Kruuse, East Greenland, p. 172.

Loc. Ymers Nunatak; Germania Land: Danmarks Havn, common.

Flow. June 20th 07.

Note. Around Danmarks Havn it was very common; in the interior only one specimen was found, on the Ymers Nunatak. It grows in humid, clayey soil on gentle slopes which are irrigated until late in summer by melting snow-drifts. During the flowering period the stolons produce new rosettes, and in the course of time a colony or association is formed consisting of closely placed individuals.

70. **Saxifraga cernua** L. Sp. pl., 1753, p. 403; Lange, Consp. Fl. Groenl., 1880, p. 61.

Kruuse, East Greenland, p. 170.
Duc d'Orleans, Cape Bismarck and Cape St. Jacques (Ostenfeld, 1908, p. 7).

Loc. Lambert Land; Cape Marie Valdemar; Germania Land: common around Danmarks Havn.
Flow. July 3rd 07.

71. **Saxifraga rivularis** L. Sp. pl., 1753, p. 404; Lange, Consp. Fl. Groenl., p. 61, 1880.

Kruuse, East Greenland, p. 170.
Duc d'Orleans, Cape St. Jacques (Ostenfeld, 1908, p. 7).

Loc. Germania Land: Dove Bugt, Danmarks Havn, common.
Flow. July 10th.

72. **Saxifraga groenlandica** L. Sp. pl., 1753, p. 404; Simmons, Sec. Arct. Exp. Fram 1898—1902, No. 2, 1906, p. 70; *S. decipiens* Ehrh.; Lange, Consp. Fl. Groenl., 1880, p. 62; *S. caespitosa* L. Sp. pl., 1753, p. 404 (saltem ex pte).

Kruuse, East Greenland, p. 171.
Duc d'Orleans, Cape Bismarck, Maroussia Isl. and Cape St. Jacques (Ostenfeld, 1908, p. 7).

All the specimens collected must be referred to var. *uniflora* (R. Br.) Simm., l. c., p. 71.

Loc. Germania Land, common; St. Koldewey.
Flow. Middle of June.

73. **Saxifraga stellaris** L., var. **comosa** Retz., Fl. Scand. Prodrom., 1779, p. 79; Lange, Consp. Fl. Groenl., 1880, p. 60.

Kruuse, East Greenland, p. 170.

Loc. Bjørneskærene; Germania Land: common around Danmarks Havn.

74. **Saxifraga nivalis** L. Sp. pl., 1753, p. 401; Lange, Consp. Fl. Groenl., 1880, p. 59.

Kruuse, East Greenland, p. 169.
Duc d'Orleans, Cape St. Jacques (Ostenfeld, 1908, p. 7).

Besides the type the var. *tenuis* Wahlenb. (Fl. Lapp., 1812, p. 114) has been collected around Danmarks Havn.

Loc. Lambert Land; Germania Land: common everywhere around Danmarks Havn.
Flow. June 21st 08.

Rosaceae.

Potentilla L.

75. **Potentilla pulchella** R. Br. in Ross, Voy., ed. 2, 1819, p. 193; Lange, Consp. Fl. Groenl., 1880, p. 4; Th. Wolf, Monogr. Potentilla, 1908, p. 151.

Kruuse, East Greenland, p. 149.

Among the specimens collected there are some with very small and densely hairy leaves; they represent the extreme limit of f. *humilis* Lange (l. c.); others are more typical and some approach the f. *elatior* Lange.

Loc. Hyde Fjord (Peary Land); Cape St. Jacques; Ymers Nunatak; Germania Land: Dove Bugt, Snenæs, Stormkap, Harefjeld; Maroussia Isl.; St. Koldewey.

Flow. June 28th 08.

Note. It was rather common on Maroussia Island which is a large, manured nesting-place of sea-fowl. With this exception it does not occur near the coast, and was not found more outward than Stormkap (a single individual from Harefjeld excepted), whence it increases in frequency until, on the gravelly banks at Dove Bugt, it becomes a character plant, just as *Lesquerella* (see p. 23). — It is a hardy species which endures well both sand-drifts and snow-storms, but it varies greatly in habit; the wind-affected individuals from the gravelly banks do not bear much resemblance to large sheltered tufts which have been snow-covered during winter; they form compact "pillars" with a few living leaves in the dense top-rosette (see Pl. V).

76. **Potentilla nivea** L. Sp. pl. 1753, p. 499; Lange, Consp. Fl. Groenl., 1880, p. 8; P. Rydberg, Monogr. N. Am. Potent., 1898, p. 84; Th. Wolf, Monogr. Potentilla, 1908, p. 233.

Kruuse, East Greenland, p. 150.

The specimens collected vary somewhat, as is usual with specimens of arctic *P. nivea*. But I think that they may all be named var. *pinnatifida* Lehm. (Pugill. plant. IX, Hamburg, 1851, p. 67; Th. Wolf (l. c., p. 239) emendavit) under which variety I place f. *subquinata* Lange (l. c., p. 9). I fully agree with Th. Wolf in not following P. Rydberg (Bull. Torr. Bot. Club., 28, 1901, p. 181), who makes a separate species of Lange's form.

As to the var. *prostrata* (Rottböll) Lehm., Monogr. Potent., 1820, p. 184 (*P. prostrata* Rottböll, Kiöbenhavn, Selsk. Skrifter, Deel 10, 1770, p. 453) much has been written about it, and it has puzzled the authors highly. We have in the Copenhagen Herbarium a specimen collected by Holböll at Umanak in West Greenland, and this belongs without doubt to the specimens upon which Rottböll's has based his description. This specimen is a very coarse and large-leaved plant with ternate, deeply incised leaves. I think it is a luxurious form of var. *pinnatifida* Lehm., which had been growing

in manured soil. It seems as if Th. Wolf (l. c., p. 238) has supposed something like this, but he gives it as related to var. *macrophylla* Ser. (D. C., Prodrom. II, 571, 1825), which is nearer to the typical *P. nivea*, than is Holböll's plant.

Loc. Ymers Nunatak; Germania Land: valley between Annexsø and Sælsø, Dove Bugt, Danmarks Havn; St. Koldewey.

Flow. June 22nd 08.

Note. Rather common around Danmarks Havn, but still more frequent landward; it grows on gravelly slopes, snow-covered during winter.

77. **Potentilla emarginata** Pursh, Fl. Am. Septentr., 1814, p. 353; Lange, Consp. Fl. Groenl., 1880, p. 8; Th. Wolf, Monogr. Potentilla, 1908, p. 533.

Kruuse, East Greenland, p. 150.

Duc d'Orleans, Cape Bismarck (Ostenfeld, 1908, p. 5).

Both low and hairy, and higher and less hairy forms were collected, thus corresponding to f. *typica* and f. *elatior* Abromeit (Bibl. Botan., 42, 1899, p. 8) respectively.

Loc. Cape St. Jacques; Cape Marie Valdemar; Germania Land: Danmarks Havn, common; Maroussia Isl.

Flow. June 27th 07; June 17th 08.

Dryas L.

78. **Dryas octopetala** L. Sp. pl., 1753, p. 717; Lange, Consp. Fl. Groenl., p. 2, 1880; N. Hartz, Medd. Groenl., 18, 1895, p. 319.

Kruuse, East Greenland, p. 148.

Duc d'Orleans, Cape St. Jacques, Cape Bismarck (Ostenfeld, 1908, p. 5).

Among the plants brought home by the Danmark Expedition I did not find any belonging to the typical *D. integrifolia* M. Vahl. The whole material from Germania Land is true *D. octopetala* L. in its small-leaved high-arctic form: f. *minor* Hook. (Transact. Linn. Soc., 14, 1825, p. 387); some specimens are hairy on the upper side of the leaves and may be referred to subf. *hirsuta* N. Hartz (l. c.), and in some localities the subf. *argentea* A. Blytt (Norges Flora, vol. 3, 1876, p. 1176), with leaves silver-white lanate on the upper side was observed.

The fragmentary specimens collected by Captain Koch on Peary Land (Hyde Fjord) stand between *D. octopetala* and *D. integrifolia* and may be *D. octopetala*, var. *intermedia* Nathorst (Öfv. K. Vet. Akad. Förh. 1884, No. 1, p. 24), but the material is too scanty for definite decision of the question.

Loc. Hyde Fjord (var. *intermedia*); Cape St. Jacques; Ymers Nunatak; Cape Marie Valdemar; Germania Land: Dove Bugt, Danmarks Havn, common; St. Koldewey.

Flow. June 27th 07, June 16th 08.

Note. It is one of the few species which flowers during the whole summer, more or less early according to its different habitats. — The

large-leaved specimens (leaves as much as 7·5 mm. broad) grow in places that are snow-covered; they are the first to develop in spring, as they have plenty of water and utilize the warmth of the sun even before the snow has melted.

Empetraceae.

Empetrum L.

79. **Empetrum nigrum** L. Sp. pl., 1753, p. 1022; Lange, Consp. Fl. Groenl., 1880, p. 18.

Kruuse, East Greenland, p. 153.

Loc. Germania Land: Danmarks Havn, Stormkap.

Note. It was found on August 1st 1907 with small unripe fruits, which did not mature during that summer; nor did the year-old fruits found in the specimens appear to have ripened. Near Danmarks Havn it occurred on heather-moor together with *Cassiope* and *Salix herbacea*. Further, some half-withered and stunted fragments were seen on a gravelly bank near Stormkap, but only sterile (Sept. 1st 07).

Onagraceae.

Epilobium L.

80. **Epilobium latifolium** L. Sp. pl., 1753, p. 347; *Chamaenerium latifolium* Sweet, Hort. Brit., ed. 2, 1830, p. 90; Lange, Consp. Fl. Groenl., 1880, p. 16.

Kruuse, East Greenland, p. 152.

Loc. Germania Land: Danmarks Havn and landward around Dove Bugt.

Flow. Beginning of July.

Note. Rather common in stony and gravelly soil near water-courses and on slopes with running water; it is sometimes so conspicuous that it catches the eye from a distance.

Halorrhagidaceae.

Hippuris L.

81. **Hippuris vulgaris** L. Sp. pl., 1753, p. 4; Lange, Consp. Fl. Groenl., 1880, p. 13.

Kruuse, East Greenland, p. 151.

The specimens collected belong to the true *H. vulgaris* and cannot be referred to the broad-leaved form: *H. tetraphylla* L. fil. (= *H. maritima* Hell.), although they bear some resemblance to it (see Pl. VI).

Loc. Germania Land: Danmarks Havn.

Note. Occurs here and there in ponds in shallow water, and flowers.

Ericaceae.

Cassiope D. Don.

82. **Cassiope tetragona** (L.) D. Don, Edinb. New Philos. Journ., 17, 1834, p. 157; Lange, Consp. Fl. Groenl., 1880, p. 87.

Kruuse, East Greenland, p. 179.
Duc d'Orleans, Cape Bismarck (Ostenfeld, 1908, p. 8).

Loc. Cape Marie Valdemar; Germania Land: Dove Bugt, Danmarks Havn, common.
Flow. June 29th 07, June 27th 08.
Note. Snow-covered during winter. Prefers rather humid slopes; in flat ground only in depressions and in the furrows formed by the water from melting snow and ice.

Rhododendron L.

83. **Rhododendron lapponicum** (L.) Wahlenb., Fl. Suec., 1824, p. 249; Lange, Consp. Fl. Groenl., 1880, p. 88.

Kruuse, East Greenland, p. 180.

Loc. Germania Land, only in the interior: Rypefjeld, Fuglenæbsfjeld, Hvalrosodde, Moskusoksefjelde.
Flow. July 2nd 08.
Note. Grows on heather-moors with long-lasting snow-covering.

Vacciniaceae.

Vaccinium L.

84. **Vaccinium uliginosum** L. (Sp. pl., 1753, p. 350), var. **microphyllum** Lange, Consp. Fl. Groenl., 1880, p. 91 (pro subspecie).

Kruuse, East Greenland, p. 181.

Loc. Germania Land: rather common from Danmarks Havn landward to Dove Bugt.
Flow. July 3rd 07, June 27th 08.
Note. It grows by preference on slopes facing south that are sheltered and snow-covered during winter and sufficiently humid during summer. It often forms a belt between *Dryas* and *Cassiope*. It was found with ripe berries, rather sparingly, on the last days of August 1906 and 1907.

Plumbaginaceae.

Statice L.

85. **Statice armeria** L. (Sp. pl., 1753, p. 274), var. **sibirica** (Turcz.) Rosenvinge, Medd. Grönland, III, 3, 1892, p. 683 (sub Armeria vulgari Willd.); *Armeria sibirica* Turcz.; Lange, Consp. Fl. Groenl., 1880, p. 70; *Statice maritima* Mill., var. *sibirica* Simmons, Sec. Arc. Exp. Fram 1898–1902, No. 2, p. 34, 1906.

Kruuse, East Greenland, p. 174.

Loc. Germania Land: common around Danmarks Havn.
Flow. July 11th 07.

Scrophulariaceae.

Pedicularis L.

86. **Pedicularis flammea** L. Sp. pl., 1753, p. 609; Lange, Consp. Fl. Groenl., 1880, p. 75.

Kruuse, East Greenland, p. 176.

Loc. Germania Land: in only one place, Rypefjeld.
Flow. July 8th 08.

87. **Pedicularis hirsuta** L. Sp. pl., 1753, p. 609; Lange, Consp. Fl. Groenl., 1880, p. 76.

Kruuse, East Greenland, p. 176.
Duc d'Orleans, Maroussia Isl. and Cape St. Jacques (Ostenfeld, 1908, p. 7).

Loc. Hyde Fjord (Peary Land); Bjørneskær; Germania Land: common everywhere around Danmarks Havn.
Flow. June 22nd 07, June 26th 08.

Campanulaceae.

Campanula L.

88. **Campanula uniflora** L. Sp. pl., 1753, p. 163, Lange, Consp. Fl. Groenl., 1880, p. 92.

Kruuse, East Greenland, p. 181.

Loc. Germania Land, here and there.
Flow. July 10th 07, July 5th 08.
Note. Grows both in sheltered places and on rocky-flats between stones, which retain the snow during winter.

Compositae.

Erigeron L.

89. **Erigeron compositus** Pursh, Fl. Am. Septentr., II, 1814, p. 535; Lange, Consp. Fl. Groenl., 1880, p. 101.

Kruuse, East Greenland, p. 183.

Loc. Cape Amélie; Germania Land, rather common.
Flow. July 10th 07, July 5th 08.
Note. Grows in gravelly places on the rocky-flats.

Arnica L.

90. **Arnica alpina** (L.) Olin, Disser. Arnica, Upsala, 1799; Lange, Consp. Fl. Groenl., 1880, p. 103.

Kruuse, East Greenland, p. 184.

Loc. Germania Land: Fuglenæbsfjeld, "Bastionen," Danmarks Havn, rare.
Flow. July 3rd 08.
Note. Grows always in the higher parts of the country on rock-ledges which are sheltered and densely snow-covered during winter.

Taraxacum L.

91. **Taraxacum arcticum** (Trautv.) Dahlstedt, Ark. f. Botanik, Stockholm, IV, No. 8, 1905, p. 8; Ostenfeld, in Duc d'Orleans, Croisière Oceanogr. mer du Grönland 1905, Bruxelles, 1908, p. 8.

Kruuse, East Greenland, p. 182 (*T. phymatocarpum* ex max. pte).
Duc d'Orleans, Cape St. Jacques and Maroussia Isl.

Both the principal form and the f. *albiflora* Kjellman (Vega Exp. vet. iakt., Stockholm, I, 1882, p. 505, sub *T. phymatocarpo*) were collected.

Loc. Germania Land, rather common.
Flow. July 10th 07.
Note. It occurs on low slopes and similar sheltered places which have been snow-covered during the winter.

92. **Taraxacum phymatocarpum** J. Vahl, Fl. dan., XIII, fasc. 39, 1840, p. 6, tab. 2298; Dahlstedt, Ark. f. Botanik, Stockholm, IV, 8, 1905, p. 22.

Kruuse, East Greenland, p. 182 (ex min. pte).

Loc. Germania Land: Rypefjeld, Snenæs and Stormkap (finished flowering Aug. 19th 1906), not common around Danmarks Havn.
Flow. July 7th 07; June 30th 08.

10—12—1909.

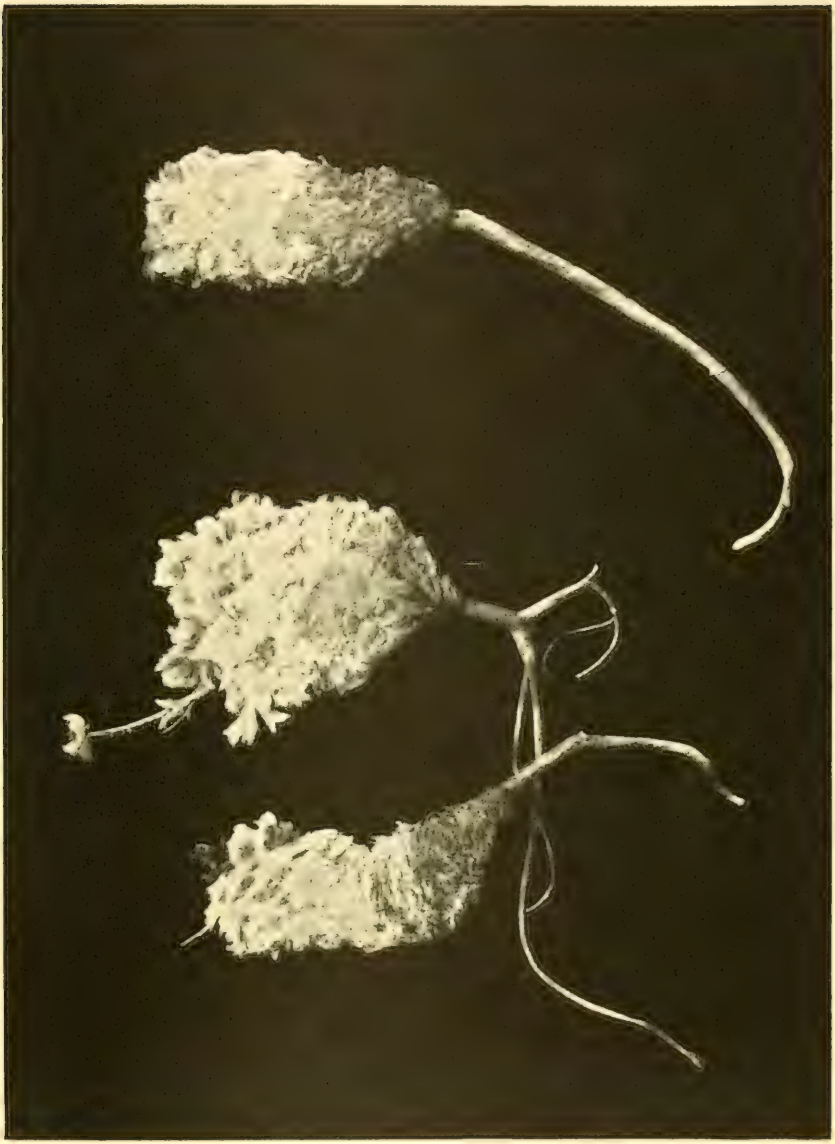
Aira caespitosa, var. *arctica* (Trin.) Simm. ($^3/_4$ nat. size.)
A high and coarse form.

Fig. 1. *Aira caespitosa*, var. *arctica* (Trin.) Simm. (3/4 nat. size.)
The form answering to *A. brevifolia* R. Br.

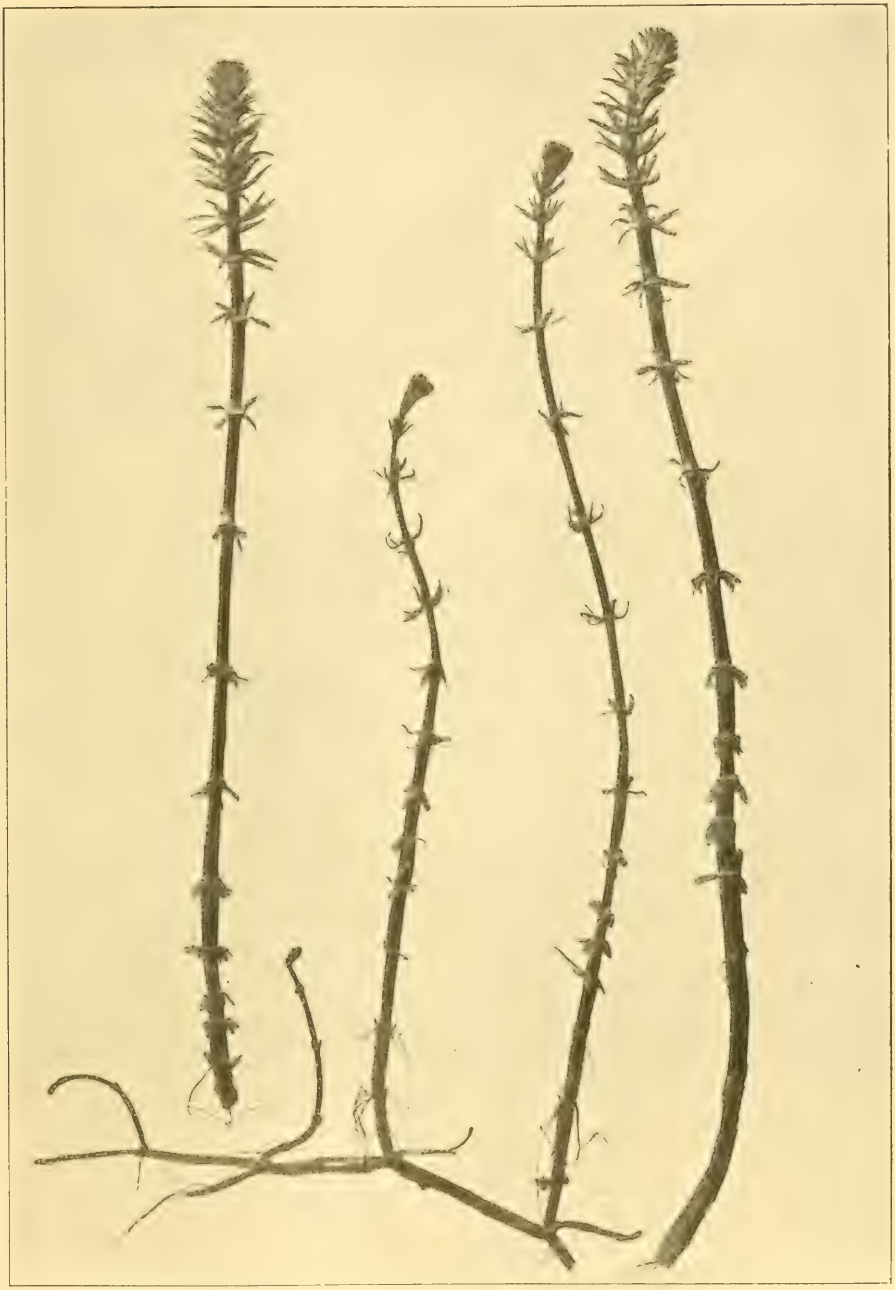
Fig. 2. *Aira caespitosa*, var. *pumila* Ledeb. (3/4 nat. size.)
The form answering to Trinius's illustration.

Aira caespitosa, var. *pumila* Ledeb. (3/4 nat. size.)
A form resembling *A. setacea* in habit.

Large-flowered *Saxifraga oppositifolia* L. (Nat. size). Photo. of living specimens by A. Lundager.



Potentilla pulchella R. Br., "pillars." (Nat. size.)



Hippuris vulgaris L., flowering specimens. (1/2 nat. size.)

II.

THE INSECTS OF THE "DANMARK" EXPEDITION

BY

FRITZ JOHANSEN AND I. C. NIELSEN

(WITH PLATES VII—VIII

1910

Fig. 1. Lake at the Harbour. August.

I. GENERAL REMARKS ON THE LIFE OF INSECTS AND ARACHNIDS IN NORTH-EAST GREENLAND.

BY

FRITZ JOHANSEN.

The "Danmark" Expedition was stationed at "Danmark's Havn" (76° 46′ N. L., 18° 14′ W. L.) from August 17th 1906 to July 21st 1908. The investigations on the insect life thus extended over the latter half of August 1906, the summer of 1907 and the early summer of 1908.

Three parts mainly of the country were investigated, near the outer coast (ship's harbour), further up the fjord ("Stormkap") and right in at the head of the fjord ("Hvalrosodden"). The physical features are naturally not quite the same at these three different places, but the following general remarks may be made regarding them. The ground consists mainly of raised sea-bottom, in the form usually of extensive, flat, gravel or clay plains with practically no vegetation, the latter being found almost exclusively in the damper, small depressions or in larger or smaller valleys, and that especially along the courses of running water and freshwater lakes. Further inland these plains change over in places to large stretches of stony

ground, often more hillocky in appearance than the gravel and clay plains; but so far as vegetation is concerned and the insect life connected therewith, there is not much to choose between these different kinds of ground. It is only in the shelter of large stones, near water and in depressions, that any vegetation is found, and this is often most abundant at the foot of the fells and larger cliffs which mark the boundary towards the higher land behind. The fertile parts of the gravel and clay plains, in addition to the above-mentioned, are the slopes which receive large supplies of water from the melting snows of early summer, and larger or smaller stretches of mossy vegetation are often found there. These disappear as the summer advances; but at special places, were the drainage is more impeded, these mossy stretches are found throughout the whole year, for example, at "Stormkap" ("Mosen") and "Basissletten" at the harbour. Characteristic parts of the country are further the now quite or almost dry beds of rivers, formed during a period when the quantities of melting snow were much more abundant than at present, when it is only in the early summer that the largest water-courses are impassable, though an exception to this is formed by the extensive "Laxeelv" at "Hvalrosodden". The ground consists here either of higher or lower clay slopes, furrowed by dried-up beds of rivulets ("Hvalrosodden"), or of extensive gravel slopes and mounds ("Stormkap"), or of picturesque clefts with waterfalls from the steep sides of cliffs and scattered stone boulders ("Rypefjeld" at "Hvalrosodden" and several other places). The two first-named river-beds are just as desolate as the surrounding plains, whilst the last kind with its rich vegetation can be noticed already from a distance as green bands in the surrounding, bare fells. Lastly, I may mention the fells lying further inland, which generally only have vegetation in the clefts or on sheltered slopes and terraces.

With regard to the detailed account of the vegetation, reference may be made to the botanical portion of this work; at present, only a summary need be given of the most characteristic plants and their distribution. The dry gravel plains support a scattered vegetation of *Salix polaris*, *Saxifraga oppositifolia*, *Potentilla* and *Papaver nudicaule*; in the small, damp hollows and depressions we find especially *Dryas octopetala*, *Cassiope tetragona*, *Vaccinium microphyllum*, *Silene*. Moss-bogs and water-courses are characterized by *Pedicularis*, *Eriophorum*, *Ranunculus glacialis* in grass and moss. In the shelter of large stones or small cliffs, on the fells and such like, we often find tufts of grass and the white-flowered *Saxifraga*,

in addition to the common plants mentioned above under the dry gravel plains. Naturally, however, there are also many places where all the plants of the species mentioned are found growing together, especially if the places are sheltered or damp.

It is difficult to give a general account of the temperature conditions at the different seasons, which indeed are of vital importance to insect life in North-East Greenland, as the three summers and two winters the Expedition spent there were so different from one another (see the account of the meteorology). In general, however, the following may be said.

The summer is considered to end a little after the beginning of September (about the 7th), when the temperature sinks somewhat abruptly, being even in the daytime under the freezing-point (mean temperature ca. —5°[1], minimum —10° to —15°), though the first, persistent snow usually falls only at the end of the month. During the most of August however the night temperature becomes regularly more and more negative (sen below, under August).

The winter may be considered, as far as temperature is concerned, to extend from September to April, both months inclusive. The lowest winter temperature, which was taken at "Danmark's Harbour", was ca. —40°. The snow-fall in the winter varies from year to year. Usually the snow comes with strong, north-westerly storms, especially at the beginning of the dark period (November) and towards the end of the winter (March).

The summer may be divided into 3 periods: an early summer (May and first half of June), high summer (until the middle of August) and late summer (until the first week in September).

The first half of May is in general different from the last half. We then have usually clear, calm weather with a temperature at noon of up to ca. —5° and at night of ca. —15°; but as the month advances, this great difference in temperature between day and night becomes less distinct, heavy fogs or strong winds being the rule. Frost at night is now less in general, and the temperature at noon may on a few days reach +5°.

In June fogs and winds also prevail during a greater or fewer number of days, but the mean temperature is positive, a few degrees above 0°, even though frost at night (down to ca. —7°) is frequent

[1] All the temperatures are Celsius.

especially in the beginning of the month. The maximum temperature is ca. +11°.

In July the weather is as a rule fine; as abnormal may be mentioned the rainy days about the 20th in 1907 and fog and snow about the middle of the month in 1908. The mean temperature is +3° to +5°; the minimum fluctuates about freezing-point; the maximum +10° to +15°. The highest temperature obtained during the whole of the Expedition (+17°) fell in this month.

August. Fine, calm weather as in July; but later in the month the difference between the day and night temperature gradually becomes greater (up to 7°), that is, the frost is increasing at nights. The maximum temperature is ca. +12°, the mean ca. +2°, the minimum ca. —5°.

Before passing to account of the insectan life in general, such as is found at the different seasons, I wish to make the following remarks.

As mentioned above, the climatic conditions during the period we were at North-East Greenland were not a little different from year to year. The summer of 1906 (of which however we only had the later part) must have been on the whole a good summer, that is, the fjords and sounds were free of ice, the land very bare of snow and the summer on the whole of long duration (i. e. the night frost came later and was less, and the sea remained open later — all by comparison with the summer of 1907). During the latter the sea-ice in the inner part of the fjord never broke up, with the result that many of the sea-birds did not breed that summer, and the frost at night suddenly became heavy (— 6°) at the end of August. On the other hand, the land was earlier bare of snow in 1907 than in 1908, as the snowfall in the winter of the former was much less than in the latter, and May and June of 1908 had somewhat more foggy weather than the corresponding months of 1907. The mean temperature however was lower in 1907 than in 1908. In 1908 the ice broke up to a much greater extent (and earlier) than in 1907; so that taken altogether 1907 was a bad summer in contrast to 1908, when the summer showed signs of becoming normal (i. e. as in 1906).

It will be seen, therefore, how difficult it is to give a general picture of the insect life at North-East Greenland, as 1907 was just the only complete summer we had, and that was abnormal.

As above mentioned, the winter at North-East Greenland may be considered as beginning about the first week in September. The small number of insects occurring about this time indicates distinctly that winter is close at hand. Most of the migrating birds are away, the freshwater lakes bear fairly thick ice and new ice has begun to form in the quieter parts of the harbour. The mossy bogs are almost dried up and the water remaining in the rivers is scarcely flowing. Digging in the ground we find it frozen even in the upper layers; and the withered leaves and dried fruits give the stretches of vegetation a uniformly, brownish-yellow appearance.

Fig. 2. At the Harbour. April.

The weather is in general fine and calm, but the sun which lends the frozen ice-fields and the clouds the most beautiful colours of red, yellow and blue-green, just confirms the impression of the surrounding land as an empty waste. It is as if the land was dead and stiff and only waited for the snow to come and spread itself like a sheltering cover over the plants and stones. It is only with the most careful search that we can find any trace of the hibernating insects; many stones must be turned over before we come upon a rolled-up little spider or mite, though these are much more frequent than the large downy larvae of *Dasychira groenlandica*, which seek a similar hiding place. And especially later on in the winter, when the snow has fallen and by thawing become unevenly dis-

tributed, so that it fills the clefts and lies in mounds round the large stones whilst the more sheltered places are entirely or partially bare, it is very difficult to find the hibernating lepidopterous larvae (*Anarta* etc.) even in the grass tufts and Dryas beds, which are not covered by snow. According to all the observations I have made on the hibernating lepidopterous larvae, it is almost exclusively on the parts of the low land which are driest, free of snow and lie high (and in consequence with but little vegetation), that we find the animals. Here in Denmark we are accustomed to find them on plant-covered ground, and it takes some time to realize that the conditions in Greenland seem to be precisely the opposite. I have searched through large tracts with heather, moss etc., without finding more than quite a few larvae, but if I disturbed a solitary grass tuft standing on a gravelly, naked spot, I could be almost always certain of finding what I sought for. The same was the case when I turned over flat stones on naked ground or ground with vegetation on it. As pointed out by DEICHMANN[1] this condition is due to the larvae preferring places where there is most promise of escaping the water from the melting snow. That the larvae never pay any attention to the protection a covering layer of snow can afford them against the cold, is likewise a characteristic feature and indicates a peculiar hardiness on the part of these animals. I may here quote from my Journal regarding the discovery of such a hibernating larva. "Found to day a naked *Anarta* larva (ca. 3 cm.) in a tuft of *Dryas octopetala*. The plant was almost free of snow and the larva was only half hidden in this, the head and front part of the body sticking down among the small twigs whilst the abdomen was bent and hung free in the air. The animal was frozen stiff and did not move when touched; the ground under the tuft was stony and hard frozen, there being a little ice between the leaves of the plant and on the body of the larva. I placed it in a box and when I reached the ship shortly after and took it from my pocket the larva was almost thawed. I watched how it gradually came to life; first it lay on its side and waved the body slowly backwards and forwards; then it turned over on to its belly and took hold on the bottom of the box with its hindmost grasping feet; slow and spasmodic contractions or waves passed along the body; finally, it fixed the other grasping feet and the thorasic legs and moved slowly away in the normal manner. The temperature that evening was $-16^1/_2°$ ($^3/_5$ 07). I tried to hatch out the larva and a week later it began to spin a cocoon, some threads being found under its belly. Two days later,

[1] "Meddelelser om Grönland" XIX. Copenhagen 1895, p. 101.

however, it gave up doing this and lay as if dead on the bottom of the glass, and as it refused to take any food it only remained alive two days longer".

The above may be considered as typical of the hibernating butterfly larvae, whether found in tufts of plants or under stones. If one is fortunate, the black Hemipter *Nysius* may also be found passing its winter sleep in the grass and such like, or a solitary queen of *Bombus hyperboreus*, and by digging into the ground (a difficult task at this time of year) the hibernating larvae of *Tipula arctica* and other Dipters. Otherwise most of the entomological collections obtained on the ground at this time of year consist of year-old, empty egg-capsules of spiders (under flat, loose stones) and ruptured pupa cases of flies (especially amongst the moss) and butterflies (below stones, in tufts of plants).

If we come now to a freshwater lake, we find, if it is not frozen to the bottom, a much richer animal life. Looking down through the ice we can see masses of the quite small, reddish brown *Cyclops* hopping about in the water right down to the bottom; the dark-brown *Daphniae* are constantly moving about with great leaps or springs, or some of them are dead but have left behind their edged and flat winter-eggs to sink down to the bottom of the lake; *Apus glacialis* in different sizes swims up under the ice, crawls over the plants or hastily buries itself down in the mud. Taking some of the latter up we find living in it numerous, red larvae of gnats (*Chironomus*); other gnats also hibernate as larvae. As all the lakes there, which are shallower than 1—2 meters, freeze to the bottom in winter, all these (mainly littoral) animal forms must be able to stand being frozen in the mud for a long time. If the frost surprises them up in the water, however, they undoubtedly die — a fact of which I have seen many examples in North-East Greenland (where the ice is often found full of dead *Apus glacialis*).

For the sake of completeness it may be added, that the parasitic insects there (the louse *Haematopinus trichechi* on *Trichechus rosmarus*, *Pulex glacialis* on *Lepus variabilis* and the various *Mallophagae* on *Corvus corax*, *Lagopus mutus* etc.) are just as common in winter as in summer.

There is no true spring in North-East Greenland. Gradually as the sun remains longer and longer above the horizon and its warming capacity increases from day to day, the snow slowly melts and evaporates; larger and smaller spots of ground become free of snow; a hole is first formed in the snow where a tuft of grass or

plants stick up and the earlier half-hidden rocks and larger stones stand out bare. The numerous water-courses still lie bound under their ice-cover and the only water seen is in the holes formed by the sun round about the seaweed frozen into the sea ice. At this time the first insects of the year are seen; if the weather is calm and sunny, one is surprised by the buzzing of a blow-fly (*Calliphora groenlandica*) round about the tent and if we approach the side of a fell where there is shelter, we find other Dipters, sometimes flying about, at others resting for a moment. Examining the ground we become aware of a spider which quickly conceals itself in the withered grass, and more are found in the crevices of the rocks, under stones and such like, where they first simulate death, but soon show themselves to be fully alive to the coming of summer. If we happen to be near a bank of sand, we notice a number of small holes with the small, red mites (*Trombidium*) crawling in and out of them — but only when the sun is shining. No other "insects" are to be seen at this time (first half of May), unless we take the trouble of investigating the tufts of grass and turn over the stones; then we find the larvae of the hibernating butterflies; for example, if it is a *Dryas* plant, we find the larvae lying under the outermost branches and twigs, which are prostrate on the ground; it is driest here and the action of the sun is strongest on this part of the plant. That the larvae are awake from their winter sleep can be seen by their movements on being touched, some of them indeed were clinging fast to the under side of the branches. The first of them come out in the latter half of May, chiefly the *Anarta* and *Dasychira* larvae; and whilst the former mainly sit on the *Dryas* tufts, the latter greedily gnaw the fresh willow buds and the rosettes of leaves of *Saxifraga oppositifolia*. The temperature at noon is about freezing point, but in the warming rays of the sun the snow-free parts of the ground are some degrees higher. The larvae do not crawl very far, partly because they have enough to do in feeding after the long winter sleep, partly because they need not yet fear the water from the melting snow. — If we go now to the freshwater lakes, we find here also that the animal life has begun to wake up close to the banks where the ice has melted, and even if a thin layer of ice is formed at nights, it does not interfere with the movements of the animals here. If there is only a few centimeters of water, we find the small, red larvae of the water-mites (*Hydrachna*) seeking their prey, and numerous larvae of gnats of various size and species move about over the soft muddy bottom, sometimes making swift leaps from side to side and then running a little (*Culex*), sometimes crawling (*Tanypus*?) like *Geometra*-larvae.

But it depends naturally on both the situation and physical conditions of the different places, when precisely the insects come out at the one or the other spot (on the plant-covered rocks at the outer coast and on sheltered grounds earlier than at other places), — just as the appearance of summer is not always at the same time two years running (thus in 1908 it was much later than in 1907).

But as soon as we come into June and have a positive mean temperature, rapid advance is made by all things. The migratory birds have now arrived from the south and seek their food in the many pools of melting water, which are now formed, or at the margin of the lakes. The flies [1] are troublesome and collect in great crowds on the refuse lying about the tent, and the first gnats (*Culex nigripes*) make their presence felt in an emphatic manner. Every lake and pool is filled with the larvae of gnats and on the bottom lie dead earth-worms and larvae of flies, which the water has washed up from the bottom-soil. The ground thaws some inches down and the greater part of the low-lying land is converted to bog. The water from the melting snow, which is daily increased from the larger and smaller stretches of snow still lying, streams down over the flat, evenly sloping plains, or it follows its own-made small courses down towards the sea-ice. There is practically not a single one of the places bare of snow which is free of water, and the caterpillars appearing are badly off. Occasionally we find them drowned in the water, but they nevertheless often manage to save themselves by moving on to the higher lying tufts of grass, stones and the like, to wait there for better times.

Every day that now passes makes the summer more and more evident. Green shoots appear everywhere on the plants and the first flowers (*Saxifraga oppositifolia*, *Salix polaris*) have come out. Most of the low-lying country apart from the permanent stretches of bog and the water-courses becomes bare of snow and running water, even though the snow higher up only melts towards the end of the month when the large rivers also become free. The caterpillars are now out generally in all sizes (especially *Dasychira*); they collect the utmost possible of food before pupation takes place. Other insects now out, in addition to the flies, are small forms of gnat (*Chironomus*) and butterfly (*Penthina*), common as imagines. Occasionally we find *Dasychira* larvae which seem strangely dead, seated for example on a *Saxifraga* tuft: taking one up we find that it is fixed fast to the plant, and on tearing it loose we see that only the empty, hard skin of the larva remains, whilst a large cocoon of an ichneu-

[1] Probably hibernating as imagines.

mon fly (*Limneria Deichmanni*) has its threads fixed to the substratum and is using the larval skin as a sheltering cover. If we examine the fresh shoots of *Potentilla* and *Papaver* we find a number of larvae of *Trombidium* or the common, small bugs (*Clamydatus pulicarius*?) fixing themselves in the innermost parts of the plants, and various larger and smaller spiders are common everywhere. Lastly, if we look down into the water of the freshwater lakes, we find a no less rich animal life there; it is filled with *Chironomus*, *Tanypus*, *Culex nigripes* and other larvae of gnats, and of new forms we find masses of Ostracod nauplii on the tangled moss of the banks, and the young of *Apus glacialis*, like a pin's head in size, are hopping about in the water in the manner peculiar to these animals. Much more common, however, are the almost microscopic *Daphnia* young just hatched, but they are somewhat difficult to see in the water owing to their transparency.

We have now reached the middle of June. It is now almost impossible to follow the appearance of all the insects, and the following therefore can not make any claim to being an exhaustive account. Going up over the bog on a fine day we hear a hitherto unknown sound and soon observe a large bumble-bee (*Bombus hypercoreus*) come buzzing quickly past. If we follow to where it settles, we find it busily dusting the flowering catkins of the willows, picking out the one after the other, or crawling in under a moss-grown stone, come out again and try another place and so on. The meaning of the latter action can be ascertained if it remains underneath; removing the stone we can dig into the ground; it then appears than this is a spot which is suitable for a new dwelling-place for the bee, or perhaps it is the old dwelling-place and we may be fortunate enough to find this. It consists of a clump of cells, which lie free in a natural depression in the soil or in a lemming's burrow. The nest I found was hidden by a small mossy carpet, through which the *Bombus* female had made an outlet. While at work this bee is much taken up with its own business and is therefore easily caught; not a few hibernating females can be seen on such a summer's day. The other *Bombus* species (*B. balteatus*) is also met with now. They are typical insects of the mossy ground and the localities with plenty of vegetation, and it is surprising to find how little the weather, time of day or dampness of the ground influence their activity. As an example of this I may mention, that when wet days with steady downpour or very dense fog set in towards the end of June 1907, *Bombus* was the only flying insect I saw, even if it was not so abundant as on sunny days. Further (according to the Journal, $^{21}/_{6}$), "I came at midnight to the bog

on the slope down towards Storm Bay. Here there are several brooks running down towards the sea and a plentiful vegetation of grass, *Salix*, *Ranunculus glacialis* etc. I saw several *Bombus* flying about, busily engaged in seeking the newly opened willow catkins. They skimmed fearlessly just above the water of the brooks and crawled about on the grass and mossy tufts projecting above the water etc., and it even seemed that they like to stay long at the places where the vegetation owing to the running water was most abundant — without however wetting their wings, though their legs and hairs of the trunk were continually wet. But the constantly present and strong sun can now dry them quickly again. The

Fig. 3. Plain at the Harbour. July.

working hours of the bees are thus long at this period; they are to be seen at work during the whole 24 hours, and it is only just about midnight that fewer are out flying; probably most of them then rest before the next, long day's work." On the bodies of the bees occur parasitic mites (*Trombidium*) which attach themselves to the hairs of the body, and to judge from their size and number one would think that they would disturb the bees in their flight more than they really seem to do.

But there are other larger, and for the Greenland insect life much more important parasites now active. Now and then we notice an elegant and large insect settling on the ground with a rapid dart and actively moving its antennae and legs, and we then

see that it is one of the ichneumon flies (*Limneria Deichmanni*) which has just come out. It is the same form, whose larvae (as already described) break through the ventral skin of the *Dasychira* larva and spin the threads attaching these to the under-lying plant. By hatching out these pupae I have found, that the imago of the ichneumon bites a hole in the dorsal skin of the emptied larva and crawls out through this; — and from and with the middle of June these empty, perforated larval skins are almost just as common as the living *Dasychira* larvae. And if the larvae is not attacked by this wasp, we can almost always be sure that the parasitic flies (*Peteina stylata* etc.) have taken up the place; but whereas only one wasp develops in each larva, several flies hatch out of the host. It is not to be wondered at, therefore, that whilst the *Dasychira* larvae are the commonest insect larvae at North-East Greenland, their imagines are seen but seldom.

The flies (*Calliphora groenlandica, Scatophaga squalida* etc.) are just as common now as earlier, and we find their maggots and pupae in carcases (e. g. of *Myodes torquatus*) and bones. The larvae of the large *Tipula arctica*, as mentioned earlier, hibernate down in the ground, and if we dig at places which are mouldy and not too dry, e. g. under *Cassiope* tufts, we easily find their large maggots. A little after the end of June they assume the pupa stage and begin to work up towards the surface, and here and there under stones etc. we may find circular holes leading down to a vertical passage, in which sits the active pupa with the head end upwards. It is thus well-protected against enemies, whilst at the same time having plenty of air. At the end of the month appear the imagines; it is the male especially, which is seen and only in flight; if it rests on the ground, namely, its colour blends perfectly with that of the surroundings it prefers (bare, sunny, stony spots with patches of vegetation of *Cassiope*, grass etc.). Various "flower-flies" are also common (*Melanostoma*, *Helophilus grönlandicus*, *Syrpus*; the first chiefly on dry, clay and stony ground with little vegetation, the last two on damp, overgrown soil). Naturally, however, the commonest Diptera are the gnats. The now completely thawed lakes and pools contain millions of their larvae, from the large, red *Chironomus* which live in mud tubes open at both ends, to the small, free-living *Culex nigripes*, which is found in every water hole however small. *Tanypus* is the first to pupate (middle of June) of all the hibernating larvae; but whilst the last as well as the completed pupae are lively enough, the intermediate stages remain at rest on the bottom. A week later appear the first imagines of *Culex nigripes*[1]; they are

[1] The new brood of the year.

found chiefly on mossy stretches and both the males and females are seen, though the former are the most numerous and swarm in the air in small groups, whilst the females sit singly on the ground. Other imagines are met with flying about over the surface of the water, often drowned in this and the ruptured pupa-cases float about on the surface in thick masses. The biting insects are however not yet troublesome with their numbers.

The last insect order remaining to be mentioned is that of the butterflies. One butterfly larva (for description see p. 65) forms a roundish, compressed cocoon on the under side of flat, loose stones, the one half being pressed into depressions in the stone, whilst the other half is attached to the pieces of gravel lying below. Here it pupates in the middle of June (unless attacked by a parasitic wasp), and as the larva is only found on dry places bare of snow and poor in vegetation, the pupa is insured agains the loosely woven and thin cocoon being washed away by the water from the melting snow. The *Dasychira* larvae pupate about the same time. In size and form their cocoon resembles a pigeon's egg and is very dense; the outer surface is smooth and light-brown to yellowish white whilst short threads pass out from the under side in all directions; these serve to attach the cocoon to the grass stalks under and around in such a way that the cocoon hangs a little above the ground. We find these cocoons mainly on mossy ground and even if there is water underneath between the blades of grass, it does not damage the cocoon. I have also found cocoons, however, which were firmly attached directly to the upper side of stones. The inner layers of the cocoon have a looser and more flax-like texture than the outer, smooth layers, and the cocoon is also less dense at the broad end within which lies the head end of the pupa. The pupation of the larvae of *Anarta* and *Cidaria* proceeds in a considerably easier manner; they simply throw off the shell of the larva, which in the *Dasychira* pupa lies inside the cocoon, and the smooth, brown pupa fixes itself in between the dense leaves on the under side of the *Dryas* or other plants. With regard to the imagines, the first of these met with are small forms (*Penthina* and others), then follow *Argynnis* (ca. 25th June) and *Anarta* (probably also *Dasychira*) at the end of the month, whilst *Colias hecla* and *Lycaena aquilo* var. *orbitulus* are first met with in the beginning of July.

That the spiders, mites and spring-tails (the last under flat stones) are now common need perhaps only be mentioned; the palps of the male of the first are very much swollen, a sign that the pairing time is at hand. This applies also to *Tipula arctica*, often taken in copulation.

With July we are in the middle of summer and the insect life is now at its height. But instead of describing, as above, the successive development and appearance of the different insects, I shall give the reader an accout of a day's excursion over the grounds were I made my entomological investigations.

We are now in the middle of July. The "Danmark" lies on the open water in the harbour and to reach the land we ferry over in the forenoon. On the land the known flowers are in full blossom over the wide plain round about the the now almost dry "Basiskaer", but of insects we see very little. The species seen on a short excursion are soon enumerated; in greatest numbers are the gnats which "stand" in swarms over the lakes; sometimes we see a bee dusting the flowers or we startle a pair of large crane-flies, an *Argynnis*, *Cidaria* or other butterflies. But if we go further and examine more closely we find much more, as will be seen.

We may begin by turning over a number of the flat stones which are strewn over the plain. We can then be almost always certain that various spiders are hidden under them, among others small, black species with spherical abdomen; the females are almost always found sitting on their flat, circular egg-cocoons, which are fixed in crevices in the stones and contain new-laid, yellow eggs, whilst the males to begin with place themselves in a warlike position and raise their chelae-like palps, but soon disappear into their holes. Or we may find quite small, red or yellowish-white mites crawling about on the under side of the stone, and the young spiders rushing wildly away to the nearest hiding-place. We also see some longish, violet, small animals, which on being disturbed throw themselves up into the air and fall down again, to repeat the same manœuvre; these are of course the spring-tails which thus seek to escape being caught. We also find the pupæ of various butterflies, both living and ruptured cases — mostly the latter. On the ground about run various spiders, — some have spun their fine threads over the ground, but most of them belong to the species which catch their prey whilst on the move; in a hole at one place, for example, we find a large form which has caught a *Tipula arctica* and is now busy eating its booty (later on in the summer, we also find it bearing its egg cocoons and still later its newly hatched young on its back). On the sun-dried parts we meet with the earlier mentioned bugs (*Nysius*) often copulating, from which we can see that the males are somewhat smaller than the females. If we try to seize them, it never seems to occur to them to use their wings; they get in amongst the leaves of the plants or crawl down into the many chinks in the ground. As mostly ground-

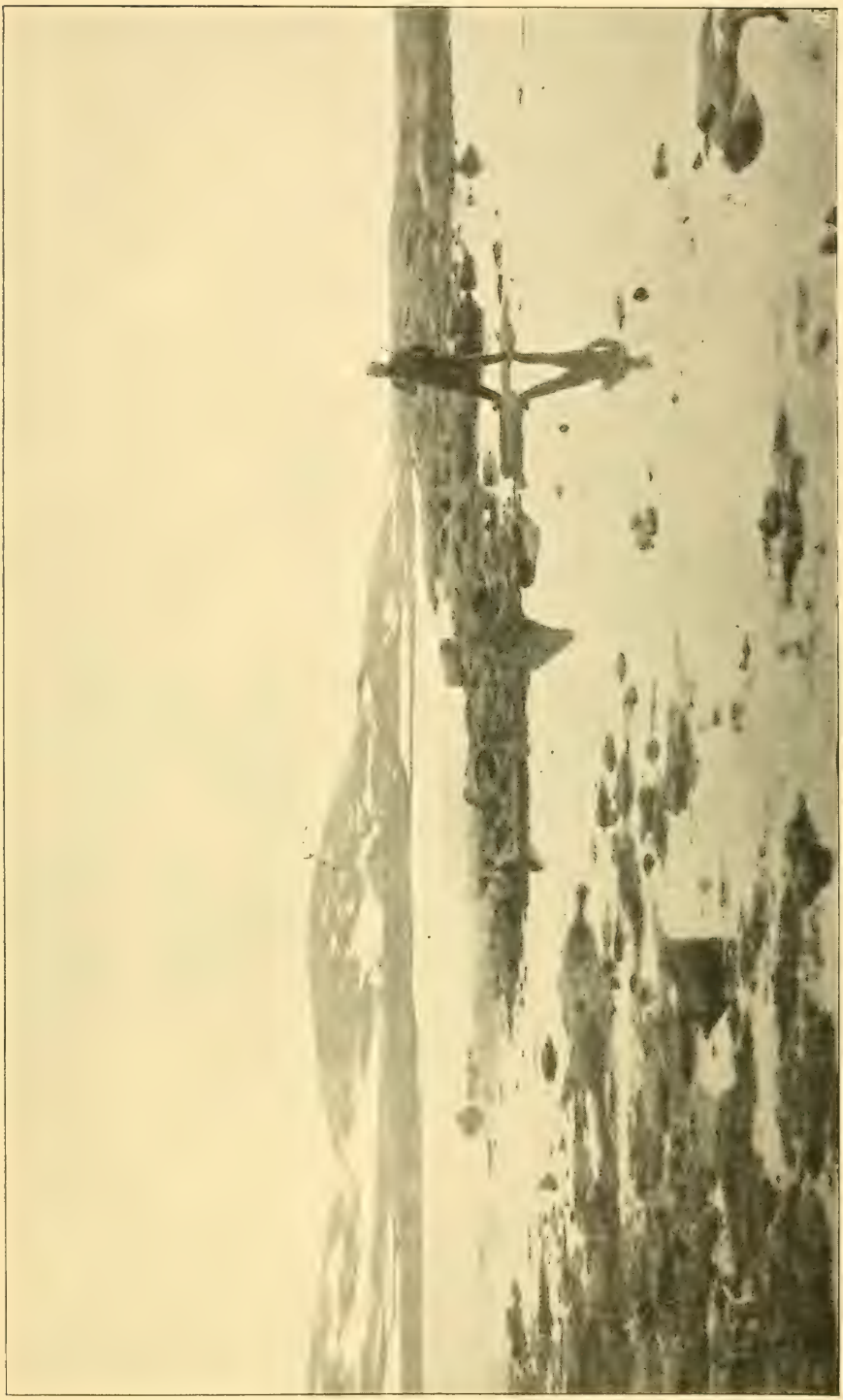


Fig. 4. Lake at the Harbour. July.

seekers we must also regard the exceedingly common, large *Tipula arctica*; as mentioned above they keep mainly to the waste places with patches of vegetation; suddenly when we have no suspicion of their presence the long-legged insects start up in front of us, leap some distance on in front and settle again not far away; and the same operation is repeated every time we come upon them unawares. And this occurs often, for its colour blends so perfectly with the stones on the ground, dried grass stalks etc., that if the animal were not so clumsy in its flight, nor so often copulating, its capture would be somewhat difficult. The gnats are now troublesome enough, but when we get beyond July month and avoid the watery localities, we do not see much of them. As at home the females fly about more singly, whilst the males swarm together over the banks of the lakes and pools. A number of them still occur as larvae in the water; and in the larger waters where *Salmo alpinus* lives, the young of the fish help to keep the stock of gnats within due bounds; in the evenings especially we can watch the "parr" swimming in small shoals in the quite shallow water and continually "making rings" on the surface, whilst snapping up the gnats which fly over the water; also, if we cut up these fishes we find them crammed with pupae and imagines. Of the flies the various "flower-flies" already mentioned are commonest in the open, and along with *Bombus* and the gnats it is they that "give the insect tone" on such a warm summer's day. — The earlier so common *Bombus* queens are now not so frequently seen; a brood of small forms (the workers) has now appeared and these care for the necessary collection of honey and pollen. As the *Salix* flowers are past, they now seek other plants (*Pedicularis*, *Dryas*) and they keep to the dry, hillocky ground, where they are often seen seeking in under the *Cassiope* plants and the like, — probably they have their nest there. Most marked of all the insects, however, are the butterflies, as it is only in the height of summer, that all are out and can be said to be common.

It is remarkable that with but few exceptions the North-East Greenland butterflies are not found on the most fertile places. On mossy ground, for example, the only common butterfly is the yellow *Colias hecla*, but this is also so much bound to such localities, that if there is a fertile slope round a larger or smaller water-course, we may be almost sure of seeing a *Colias* flitting about and be able to follow with the eye how it keeps to the windings of the slope. On large grassy plots (for example at the foot of the fells) we see several of these beautifully coloured insects flitting about; when two come nearer together they playfully cross and recross in the air before separating; the one then perhaps settles on a *Dryas* blossom whilst

the other seeks rest on a blade of grass, the colour of which it resembles so much. — The commonest day butterflies are however the *Argynnis*, but like the following they are not met with on boggy ground (nor in fact on the bare clay and stone plains). Yet we may be surprised by these butterflies flying up from ground where the dry grass, *Cassiope* and other plants are only growing in hollows here and there, until we observe that it is just these places which afford the butterfly the most shelter. When this settles for example on a stone or a *Cassiope* tuft, the reddish brown lichen covering the former, like the purple-black leaf of the latter blends so perfectly in colour with the butterfly that this cannot be seen before it starts up. It is very shy, flying often far away before it again settles, and as it "doubles" a great deal in its flight, it is more difficult to catch than *Colias*. These butterflies are sometimes seen together, however; in which case it is *Argynnis* that has come on to the grounds of *Colias* and they playfully cross one another before proceeding on their way. — More rarely and more singly we meet with the day-butterfly *Lycaena orbitulus* on localities similar to those of *Argynnis*. It is quite impossible to see this butterfly when sitting on the ground; the gray under-side of the folded wings blends so perfectly with the surrounding small stones. It does not fly far each time, but irregularly and fairly quickly. —

Among the night-butterflies the grayish *Cidaria polata* is by far the most common; it is also one of the first to appear and is met with almost everywhere on the plain; it keeps mostly to the stony patches, however, where sitting on the ground or on a stone with lichen-covering it is quite concealed by its colour-resemblance. — More rare is the large *Anarta Richardsonii*, which keeps to similar places and often sits on a large stone covered with gray lichens; if we approach or if it notices one's shadow, it flies high up in the air and goes away in a long glide, carried by the wind, until it settles on a new stone with a quick movement down to the ground. Even if we have noticed where it has settled and steadily keep the eye fixed on it, on creeping forward, we often fail to see it, so perfectly does it seem to become part of the stone. As mentioned, it is partial to the sun-dried gravelly spots with large stones and vegetation here and there, in contrast to the smaller *Anarta Zetterstedtii* which is mainly met with along the grass-covered water-courses, but is much more rare. Very common, lastly, is the small *Penthina groenlandicana*, which keeps mainly to the clumps of *Cassiope* found in the hollows of the stony ground. If we approach these plants, the small, white and black butterfly springs up and with characteristic

"glimmering" movements keeps almost above the same place until it falls to earth again.

We do not forget either to study the freshwater lakes on such an excursion; at the banks especially we find a comparatively rich animal life. The almost microscopic, reddish spring-tails are constantly hopping about on the surface of the water; it is almost impossible to capture them and when we at last get them into our glass, they clamber up its vertical sides with the greatest ease. The brick-red *Hydrachnidae* crawl about between the blades of grass, and if they catch hold of a gnat larva, we see how they hook themselves on to it and in spite of their prey's powerful writhings gradually suck out its substance. The most characteristic animals are however the *Apus glacialis*, of which we now meet with both the young and the full-grown individuals; they are continually in movement, sometimes burying themselves down into the soft mud, sometimes "creeping" over the bottom, whilst their swimming-feet make elegantly winding tracks in the brownish yellow sand. The *Ostracoda* collect about the dead animals (e. g. *Apus*) and devour them; they are the scavengers of the lakes and wander slowly over the bottom; leaving the giddy *Daphnidae* to do the springing about up in the water.

It is now late in the day. We have wandered far about over the wide plains, following the water-courses from the base of the high land down to the sea. We have passed over boggy patches and gravelly tracts, taking occasional leaps on to the large boulders on our way, and walked along the banks of the lakes. To end up our excursion we may now go towards the fells and find out what insects are met with, as we gradually mount higher up. On the slopes of the fells which bear some vegetation we now and then see a butterfly (*Argynnis*, *Cidaria*, *Penthina*), but these gradually disappear (*Cidaria* goes up the highest), and as the vegetation grows thinner (grass and a few tufts of *Cassiope*, *Papaver* and *Saxifraga*) the otherwise so common *Bombus* likewise disappears. The ground now consists mainly of bare rock, with here and there a small terrace of gravel; but no lakes are seen, with the advantage that no gnats are found here either. The only insects now seen are *Tipula arctica* and various flies (especially the earlier mentioned *Melanostoma*), and when we come to a snow drift we see the same and other insects out over the white surface, sitting in the holes in the snow the sun has melted round about them. It is probably the wind that has brought them here, and the strong light from the white snow has then completely blinded them, so that they have fallen down and helplessly perished. That they are not there of their own free

will, can be seen also by observing the insects when they come to a large snow-covered patch; they will not fly over this but prefer to make the detour round it. The same phenomen of the dead insects is also common on the sea-ice, where we find them lying scattered right from the beach to far out.

Late at night we return to the ship. The sun is now in the north but yields little warmth, yet most of the insects are still active. The *Bombus* workers continue unweariedly their search for honey and pollen, but of the flies we now see but little; this applies also to the gnats, especially the large forms; swarms of the small gnats

Fig. 5. Summit of a hill at the Harbour. August.

on the other hand still hang over the pools and brooks. *Tipula arctica* tricks us just as in the day-time, and of the butterflies the night-swarms are most in evidence. All the insects are abroad, however, even if some of the species are less active than during the day. And now the sun begins to warm to a new day; the transition period from the previous is very short, and gradually as the sun comes further and further round to the east, the insect life becomes more active. Our excursion is at an end.

Towards the middle of August the summer already begins to wane. The large *Tipula arctica* imagines are no longer seen, the swarms of gnats are now obviously decreasing and the other insects are not nearly so numerous as before. At night the frost begins to be felt towards the end of the month and the insect life is rapidly

on the down grade; the *Bombus* females begin to seek their winter quarters and here and there we find a dead butterfly, whilst the living imagines have disappeared. The air becomes strangely still, the migratory birds are ready to depart, and of the previously so lively, buzzing flies and gnats we now meet with but isolated individuals, which will clearly soon die. Spiders and mites hold out the longest and run about the whole day, whilst the still living insects have gone to their winter shelters under stones and tufts of plants. Thin ice lies on the freshwater lakes at nights and the time soon comes when the sun's warmth of the day is not sufficient to melt it; the winter has begun.

We have now completed the entomological survey of North East Greenland for one whole year. How far the various insects go in towards the inland ice I have not sufficient observations to determine, but from isolated finds it appears that at least the butterflies, flies, gnats and spiders are found right up on the "nuna land" of the inland ice. Thus amongst others an *Anarta* pupa was found in a *Dryas* plant on a peak 10—12 miles from the margin of the inland ice.

If we compare the summers of 1907 and 1908 with respect to the insect life we find the interesting condition, that although the country in 1908 was much later in becoming clear of snow than in 1907 (with the consequence that the plants began to blossom somewhat later in 1908) the insect life on land was earlier in 1908 than in 1907. The mean temperature namely was highest in 1908, and when it is likewise remembered, that the hibernating land insects (larvae etc.) are found on dry places free of snow, it becomes clear what is the most essential factor for the early or late beginning of the insect life. The animal life of the freshwater lakes, on the other hand, was much later in 1908 than in 1907, as the lakes are often the places where most snow lies and they are hardly free of ice before well into June.

II. A CATALOGUE OF THE INSECTS OF NORTH-EAST GREENLAND WITH DESCRIPTIONS OF SOME LARVÆ.

BY

I. C. NIELSEN.

The insects brought home by the "Danmark" Expedition were collected by the zoologist of the expedition, FRITZ JOHANSEN, in the neighbourhood of the place where the ship was located, 76° 46′ N. L., 18° 14′ W. L.

The insect fauna at this spot has in the main the same character as in the more southerly parts of East Greenland which have been investigated by earlier expeditions, but the number of species is somewhat smaller in consequence of the more northerly situation of the regions investigated. Nevertheless, the insect fauna shows a few striking characteristics, e. g. the complete absence of representatives of the order of beetles. I have formerly[1] remarked upon the sparse representation of this order also in other parts of East Greenland in comparison with West Greenland; this condition reaches its culmination in North-East Greenland where not a single beetle was obtained, in spite of the fact that not a few collections obviously were made at places which the beetle fauna frequents, under stones and plants, and in the water.

No species of *Pseudoneuroptera* or *Orthoptera* have yet been brought from East Greenland, though representatives of these orders are found on the west coast (the representative of the latter order, a *Blatta*, was however possibly introduced).

Similarly, no Physopods occur in the collections; the zoological journal, however, mentions a spring-tail not brought home, and of this family several species are known further south on the east coast.

Haematopinus trichechi, not previously found on the walrus of East Greenland, has now been met with here, so that the order of *Siphunculata* is also represented in this part of Greenland.

[1] I. C. NIELSEN: The Insects of East Greenland (Medd. om Grönland. XXIX, 1907, p. 366).

Hymenoptera.

From East Greenland 20 species of wasps were hitherto known, of which only 4 (5) are present in the collections, which further contain two species not previously taken in East Greenland (*Praon* sp. and *Nematus* sp.), and of these the latter is new to the Greenland fauna.

1. **Nematus** sp.

One specimen (♀). Beginning of July 1908.

From Greenland we now know in all four species of *Chalastogastra*, of which however only one specimen of each has been brought home, namely, from the west coast *Nematus obductus* Htg. and a species described by *Marlatt* [1] from Disco, *N. borealis*, of which only the type-specimen is known, and from the east coast two specifically distinct females, both of which probably belong to undescribed species.

2. **Ichneumon groenlandicus** Lbck.

One specimen. 1. July 1908.

3. **Limneria Deichmanni** Nielsen.

This species seems to be very common and to cause no little destruction among the larvae of *Dasychira groenlandica*.

The wasp lays its eggs on the one-year old *Dasychira* larvae, and these do not increase appreciably in size afterwards; they overwinter as usual, appear next spring and begin to eat, but are then killed by the parasite. I have already mentioned [2] that the larva of the parasitic wasp spins cocoons inside in the empty skin of the host larva after boring a hole through the underside of this, and through the hole it attaches the cocoon firmly to some understratum, *Dryas*-plant or grass. Such fast-spun cocoons were collected in the first days of June, and the wasp was hatched out on the 14th of the same month.

4. **Microgaster** sp.

Some empty cocoons.

5. **Praon** sp.

An *Aphis* was found attached to a stone by means of an empty wasp cocoon, with the form characteristic of the genus *Praon*, a short cone, on the truncated point of which the skin of the leaf-louse was attached. No species of this genus has hitherto been known from East Greenland; on the other hand, *Praon objectus*

[1] Proceedings of the Academy of Science of Philadelphia 1892, p. 133.

[2] I. C. NIELSEN: l. c. p. 387.

Halid. occurs on the west coast[1], and it is therefore probable that the cocoons mentioned belong to this species.

6. **Bombus hyperboreus** Schönh.

7. **B. balteatus** Dhlb.

Both the two Greenland humble-bees are common; the hibernating females appear in the middle of June and the workers appear already at the end of this month. They fly on *Salix*, *Potentilla*, *Saxifraga*, *Pedicularis* and *Cassiope*. Both species build their nests under the ground in deserted marmot holes.

A nest of *B. balteatus* was found on July 15th 1908 ca. 17 cm. under the surface. The entrance to the nest was ca. 35 cm. long. The nest was padded with a thin layer of moss and indeterminable bits of plants. Close to the entrance there was a small clump of food on which were laid about a score of humble-bee eggs, and behind this lay another clump containing a pair of tiny larvae. The nest contained some bundles of cocoons, namely, a clump of worker-cocoons which were all empty (in all 20 cocoons), further cocoons containing mature male-pupae (in all 11) and lastly cocoons with full-grown female larvae (in all 11). Some workers were found in the nest but no males or females.

A female of *B. hyperboreus* was found at the end of June in the act of crawling down into a marmot hole, presumably seeking for a place to build its nest. On digging out the marmot hole a clump of old, moulded, humble-bee cocoons was found in it.

The life-history of the Greenland humble-bees does not differ, therefore, from that of the more southern species.

Diptera.

From East Greenland ca. 50 species of flies were hitherto known, of which 15 occur in the collections, in addition also a pair of indeterminable *Muscidae*, as also two species which are new (*Rhamphomyia* sp., *Catabomba groenlandica*).

1. **Tipula arctica** Curt.

This species is common and was brought home in numbers.

The larvae are found in circular holes ca. 2—3 cm. deep in the ground, especially under *Cassiope*-tufts. The change to the pupa stage also takes place here.

The pupae were found at the end of June and empty pupa-cases were found already on the 25th of the same month. The period of flight lasts till the beginning of August.

[1] W. Lundbeck: Hymenoptera groenlandica (Vidensk. Meddelelser fra den naturhist. Forening i København, 1906, p. 242).

The larvae take two years to become full-grown.

The *larva* when full-grown is 3—4 cm. long, the colour is light-brown, darker anteriorly, with a fine silky pubescent sheen. The form is linear, pointed anteriorly, the body round in section. The segments in the middle, both on the dorsal and ventral surfaces, with a transverse row of 4 short bristles; on the underside the two innermost bristles are somewhat further forward than the two outer.

The head has the usual form in *Tipula* larvae and can be retracted into the following segment.

The antennae (fig. 1 a) are articulated to a soft area in the anterior margin of the head-capsule, they are single-jointed, brownish, thick and slightly pointed in front: the tip is soft, flatly arched and bears two sense-processes, the one broad and flatly arched (fig. 1 b) and the other narrower and more pointed. On the inner side of the antennae, almost at the middle, there is a round, scar-like area, presumably some organ of sense, recalling an organ which SIMON BENGTSSON[1] has found on the maxillary palp of the *Phalacrocera* larva (fig. 1 c).

A number of setae occur between the antennae.

The front part of the head is soft-skinned and covers the mouth-parts like a plate.

On this plate, which most probably corresponds to the clypeus and labrum in other eucephalic *Nematocera* larvae, there is on each side a chitinous list (fig. 1 d) which is bent at an angle; the posterior branch, which is parallel with the anterior border of the head and lies somewhat far from this, sends backwards a chitinous ridge which goes down towards the underside of the plate; the front branch, which is narrower than the posterior, is directed towards the anterior margin of the head; here it is again bent at an angle out towards the side of the head and from its point projects a ridge pointing obliquely forwards. In front of this terminal part of the list, on a somewhat projecting portion of the anterior margin of the head, there is a single thick, somewhat bent bristle and also a number of smaller setae.

The underside of the plate is densely beset with projecting bristles, which in front are thick, large and placed in rows, but further back become thinner and form a dense felt. On each side of the head a dense clump of bristles projects out over the anterior margin (fig. 1 e).

The mandibles (fig. 2) are strong, flattened and incised at the tip, so that they end in two teeth, of which the outer is the larger.

[1] SIMON BENGTSSON: Studier öfver Insektlarver, I. Phalacrocera replicata Lin. (Kongl. Fysiogr. Sällskapets i Lund Handlingar. Ny Följ p. 84 1897).

The inner margin bears a large appendage, corresponding to the prostheca, which Simon Bengtsson found in the *Phalacrocera* larva. The appendage is club-shaped and the point densely covered with bristles (fig. 2a).

The maxillæ are flat and blade-like; the cardo is formed by an elongated, triangular plate, which bears in front two very closely placed long bristles; the stipes is densely covered with bristles, soft-skinned, with a stronger chitinous border which surrounds the place of insertion of the palp. The palp (fig. 3) is short and thick, cylindrical; at its tip which is soft there is a group of five or six sense processes (fig. 3a). As in the *Phalacrocera* larva there is a sense-organ at the side, which consists of a soft-skinned area surrounded by a rounded chitinous ring (fig. 3b).

The underside of the head-capsule bears the underlip (ectolabium S. Bengts.), which has the form of a plate supporting anteriorly 7 rounded teeth (fig. 4), of which the central one is the largest, the others decreasing in size and the outermost quite weakly developed. Posteriorly the plate is somewhat contracted. Under this and pressed close up to it, on the underside of the mouth, there is another plate (endolabium S. Bengts.), which is somewhat smaller, broader posteriorly and drawn out in front in 5 teeth (fig. 5).

The posterior end of the larva is slightly constricted in front of the tip of the abdomen, which is flattened and shows the three pairs of caudal appendages usual in *Tipula* larvae; each of the upper pair has a small triangular, brownish plate at the base; the middle pair are the longest and the lowest the shortest (fig. 6).

The length of the pupa is ca. 2 cm. (fig. 7). On the dorsal surface of the thorax there is a pair of spiracles, which diverge somewhat and are slightly curved. The dorsal surface of the thorax is transversely rugose and bears here a pair of flat tubercles.

The abdominal segments are divided by a constriction into an anterior and a posterior part; on the dorsal surface behind the line of division they bear a row of posteriorly directed spines which increase in size towards the hind end of the larva. On the sides there are two spines, one of which is placed on the anterior margin of the joint, the other at the posterior margin. On the underside of the second abdominal joint there is a pair of spines and each of the succeeding bears a row of strong spines posteriorly.

The upper side of the anal joint has three pairs of spines standing behind one another; the last pair is found at the end of the body. The underside of the joint bears a row of 6 large spines which are situated under the front pair on the dorsal surface.

2. **Pachyrrhina Lundbeckii** Nielsen.

3 specimens; the end of June 1908.

3. **Chironomus hyperboreus** Stæg.

A number of specimens swarming over a moss on June 23 1907. All the specimens are somewhat darker than the other Greenland specimens I have seen.

4. **Chironomus** sp. **Tanypus** sp.

Several specimens of a smaller *Chironomus* which could not be determined with certainty, and several larvæ of *Chironomus* and *Tanypus* species.

5. **Culex nigripes** Zett.

Some specimens; August 1907.

A pair of larvae almost or perhaps quite full-grown have been brought home; they were all somewhat rubbed.

The length of the largest larva is ca. 12 mm. The body is greenish; the head and air-tube brown. The upper side of the head bears 6 simple bristles (fig. 8), of which 4 are placed on a flat curved line between the bases of the antennae and the two others somewhat further back between the central ones in the anterior row. On each side of the labrum there is a short and thick, inwardly curved bristle. The antennae are beset with fine serrations and have two simple bristles at the middle.

The prothorax has on each side 8 bristles, which in the younger larvae are divided into several, in the older into a large number of rays. On the anterior margin there are three, close together and a little in front of the middle three and posteriorly two single. The two succeeding segments bear on each side at the middle a bristle with several rays, the following segments on each side two bristles with several rays and posteriorly on the upper side two bristles, divided into rays.

The 8th segment has at the sides a row of pointed, posteriorly directed, depressed and elongated spines (fig. 9). On the underside there is a bristle with four rays. The air-tube is three times as long as broad. The under side has two rows of backwardly curved, fine chitinous spines (fig. 10), which bear a tooth at the base; the spines increase in size outwards and reach out to the middle of the air-tube; between the two outermost there is a bristle with three rays.

The under surface of the 9th segment bears several bristles with several rays and on the posterior margin of the under surface there are some dense clumps of bristles. The caudal appendages are almost twice the length of the ninth joint segment, narrow and pointed.

6. **Rhamphomyia** sp.

Two specimens.

This species greatly resembles *R. hirtula* Zett. in general appearance but differs in the construction of the male hypopygium and in the female having darker wings. Like *R. hirtula* it seems to be somewhat nearly related to *R. Brusewitzii* Holmgr. but according to the description the hypopygium of this species is otherwise constructed.

7. **Melanostoma ambigua** Fall.

One male from the end of June 1908; two females, the one from June 23 1907, the other from the beginning of June 1908.

8. **Helophilus groenlandicus** O. Fabr.

One specimen. $^{6}/_{8}$ 07.

9. **Syrphus tarsatus** Zett.

A couple of specimens from July 1908.

10. **S. arcuatus** Fall.

A couple of specimens from July 1908 and July 1907.

11. **Catabomba groenlandica** n. sp.

Male. The head is somewhat low and the face extraordinarily broad; the frons is distinctly inflated. The face is dark- or dirty yellow and blackish yellow towards the sides, the frons is black, but yellowish red just above the antennæ, it and the sides of the face are very slightly dusted; the jowls and the lower margin of the mouth aperture are black. The antennæ are black or blackish. The frons has very long, black hairs which extend down the cheeks. Occiput is black, somewhat greyish dusted; the bristles along the upper eye margin are black, and they are long and overhanging. The eyes are clothed with long, but not dense, white hairs; they have the upper facets distinctly larger than the lower, the small facets stretch up along the posterior margin. Thorax is dull æneous black, pleuræ of the same colour; the disk is clothed with long, black or brownish black hairs. Scutellum is blackish yellow, somewhat translucent, clothed with long, black hairs. Abdomen is æneous black, somewhat shining, the first segment a little dullish; there are three pairs of yellowish spots, those on the second segment are small and indeterminate, and they may be quite wanting, the segment then being quite black; the two other pairs are somewhat lunulate, the front margin being slightly excised, but the hind margin well rounded; the spots are situated at the front margin of the segment but are not in connection with it, and they are also well away from the side margin; the hind margin of the fourth segment is distinctly, that of the fifth segment less distinctly reddish yellow. The venter is black, sometimes with paler incisures. Abdomen is

clothed with long, black hairs; only on the second segment on and around the spots, there are paler to yellow hairs. The legs are chiefly black, the knees broadly reddish yellow, which colour extends more or less on the tibiæ, and the tibiæ may be quite reddish with a more or less distinct black ring about the middle; the hairs on the legs are black. The wings are hyaline, very slightly yellowish, with brown veins; the halters are yellowish. Length 8—10 mm.

There are four specimens of this species, all males; they are quite alike, only varying a little with regard to the presence or absence of the first pair of spots and lighter or darker legs. The species is evidently allied to the known *Catabomba* species, it is very characteristic by its extraordinarily low and broad face. 5/7 07, four specimens.

12. **Peteina stylata** B. & B.[1]

A full-grown larva of *Dasychira groenlandica*, which was caught on June 22 1907, bore 6 eggs of this parasitic fly on the side and underside of the thoracic joints. The parasitic larvae had not yet penetrated into the host.

A full-grown larva, also collected in June, was put aside for rearing, and as it was found dead in the beginning of July it was subjected to closer examination, which showed that it contained 3 scarcely full-grown, dead larvae of the parasitic fly. On this host-larva the eggs of the parasitic fly were found in a furrow on the thorax; the parasites had bored their way in through the skin and lay pressed close up against each other, in very distinct sacks of the fatty body; and their hind parts were attached to the skin of the host by means of a chitinous funnel. The digestive canal of the host was still untouched and the fatty body still not wholly consumed.

Lastly, a single parasitic larva bored its way out of a *Dasychira* larva on the 6th of July and pupated.

The eggs are almost 1 mm. long, white and without sculpture on the shell.

The larva in the 3rd stage. The length of the specimens examined, which were a little contracted, varied from 9—11 mm.

The spinous armature is found on the anterior margins of the

[1] The species was not reared so that the determination is not quite certain. I believe, however, that only *Peteina stylata* can be in question, as in addition to this species only two other parasitic flies occur in Greenland, namely, *Tachina larvarum* L. and *Echinomyia aenea* Stæg. The larvae of the first-named species are known (I. C. Nielsen: Iagttagelser over entoparasitiske Muscidelarver hos Arthropoder. Kbhvn. 1909, p. 60) and are different from the above described larvæ; the Echinomyiae are viviparous and the pupae are too small to belong to *E. aenea*. Further, *Peteina stylata* was earlier reared from the larvæ of *Dasychira groenlandica* (cf. I. C. Nielsen: The insects of East Greenland, p. 394).

2nd to the 5th segment, on the front and hind margins of the 6th, 7th and 8th segment[1] and only on the hind margins of the 9th to the 11th segments. All the spines on the front margins are directed backwards and all those on the hind margins forwards. The spines are largest on the front segments, decrease in size backwards and again become a little larger on the last segments; on the 2nd to the 4th segment they are in fairly regular straight rows, but on the 5th and following segment in shorter and somewhat curved rows. On the anal joint there is a broad girdle of spines which are directed forwards and placed in regular little rows.

On the head there is a pair of sense-organs, each of which bears two papillae, almost of the same size; the one has at the tip a clear, refracting body and the other some sense processes.

The mouth-hooks (fig. 11a) are broad and strong, not much bent; the inner side with an obtuse tooth at the middle, the base with a broad and strong, spine-like prolongation anteriorly, and posteriorly there is a somewhat more slender spine directed backwards. The mouth-hooks are jointed on the front pharyngeal plates (fig. 11b); these plates are broadest anteriorly and the upper margin straight. They are connected by means of a joint with the posterior part of the pharyngeal skeleton, which consists on each side of an upper (fig. 11c) and a lower pharyngeal plate (fig. 11d); the upper is the larger, the upper margin straight, drawn out anteriorly into an abruptly truncated, short prolongation. The posterior margin of the pharyngeal plate is evenly rounded. The lower pharyngeal plate is shorter than the upper, broadest posteriorly and here sharply incised.

The anterior spiracles (fig. 12) occur in the articulation between the second and third joint; the atrium is elongated and curved; the base broad; at the tip there are five, short-stalked branches placed in a line, those lying innermost being the largest.

The posterior spiracles (fig. 13) are situated in the flattened hind end of the body, somewhat up towards the dorsal surface; they are surrounded by a broad, black ring of chitin which sends bridges in over the spiracle; the one bridge is cleft at the tip. The bridges reach almost to the tracheal opening, which lies inside the chitinous ring. The spiracle is divided by the bridges into 3 parts, each bearing an elongated respiratory-area, the middle one of which is the shortest.

The anus lies on the ventral side at a fair distance from the hind end.

The *puparium* is ca. 9 mm. long and ca. 3 mm. broad, oval with

[1] On the hind margin of the 5th segment there are a few spines.

distinct but not deep divisions into joints, brownish, finely transversely rugose. The anterior spiracles project like two small, black buttons; the posterior spiracles not projecting. The outer pupa-spiracles could not be detected.

13. **Calliphora groenlandica** Zett.

A number of specimens, some of which were hatched from pupae found on a dog's carcase on July 17th 1907.

14. **Fucellia pictipennis** Becker.

Of this species, which was founded on specimens brought home from East Greenland by earlier expeditions, a single specimen was found in the collections.

15. **Scatophaga squalida** Meig.

A number of specimens from June to July 1908.

Suctoria.

1. **Pulex glacialis** Taschb.[1]

OTHO FABRICIUS in Fauna Groenlandica[2] noted that "*Pulex irritans*" occurred on the Greenland hare. MEINERT[3] denoted FABRICIUS' species as *P. glacialis*, which TASCHENBERG[4] had founded on specimens taken "*auf Lepus glacialis am Nordpole*". Since FABRICIUS' time no fleas have been found on hares in West Greenland; on the other hand, *P. glacialis* was found by a Swedish Expedition on hares in East Greenland[5] (Dronning Augustas Dal $^{13}/_{7}$, Ruths Island $^{16}/_{8}$ and Cape Weber $^{26}/_{8}$), and the "Danmark" Expedition has also brought home a no small number of this species, with which practically all the hares shot on the Expedition were infested.

The species is known, outside Greenland, only from Arizona, where it is found on "rabbits"[6]. With regard to the distribution in Greenland the following may be remarked. FABRICIUS, who mentioned the hare-flea from Greenland, only knew the fauna on the west coast, but since his time no fleas have ever been found on hares. One of the members of the Expedition, JØRGEN BRØNDLUND, who had hunted in West Greenland, had it specially noted in the Zoolo-

[1] The Hon. CH. ROTHSCHILD has kindly named this species.

[2] OTHO FABRICIUS: Fauna Groenlandica, p. 221.

[3] F. MEINERT: Neuroptera, Pseudoneuroptera, Thysanopoda, Mallophaga, Collembola, Suctoria, Siphunculata Groenlandica (Vidensk. Medd. fra den Naturhist. Forening i København 1896, p. 175).

[4] O. TASCHENBERG: Die Flöhe. 1880, p. 77.

[5] E. WAHLGREN: Aphanipterologische Notizen nebst Beschreibungen neuer Arten (Arkiv för Zoologi Bd. 1, 1903, p. 186).

[6] C. P. BAKER: Preliminary studies in Siphonaptera (Canadian Entomologist XXVII, 1895).

gical Journal, that it struck him as surprising that the East Greenland hares were infested with fleas, as he had never observed these on hares in West Greenland.

Lepidoptera.

Of the 20 species of butterflies hitherto known from East Greenland 9 occur in the collections, and these also contain a species new to the East Greenland fauna, *Sericoris Schultziana*.

Of the larvae of the Greenland butterflies the larva of *Dasychira* has long been known, and in 1900 Aurivillius[1] described the larvae of the two *Argynnis* species. There is a number of lepidopterous larvae in the collections, a few of which could be referred to their species; these are described here under the separate species.

A single *Heterocera* larva, which cannot be referred to any of the known Lepidoptera of Greenland, was found on June 15th along with pupae in a cocoon under flat loose stones. The larva (fig. 14) is about 8—9 mm. long, spindle-shaped; its greatest breadth falls across the 2th—3th abdominal segment.

The head is only a little narrower than the 1st thoracic segment and longer than this, almost square-shaped, brown with a few long bristles; the upper lip somewhat darker; base of the feelers light, the tip black. The first thoracic segment with a dorsal plate of the same colour as the head; the anterior margin of the plate with a row of 6 bristles, the posterior margin likewise with 6, the two innermost of which stand further in on the plate than the outer ones. The base of the bristles surrounded by faintly delimited, sometimes continuous dark spots. The two following segments and the abdominal segments light with brownish spots. The thoracic segments have almost in the middle a transverse row of 6 dark spots, of which the innermost is the largest and the outermost very small, and the hind margin has two, lying behind the outermost in the front row, with which they agree in size. The front margins of the abdominal segments with four spots, the two inner being the largest and broader than long, the outer rounded; the posterior margins with two spots, which stand behind the two central ones in the front row. The preanal and the anal segment bear a brownish plate with some bristles. Along the sides of the abdominal segments are two rows of spots and along the underside 4 rows. All the spots bear a bristle in the middle.

[1] Chr. Aurivillius: Lepidoptera och Coleoptera indsamlade under Professor A. G. Nathorst's arktiska expeditioner 1898 och 1899, under den svenska expedition till Beeren Eiland och under Konservator G. Koltoffs expedition til Grönland (Öfversigt kgl. Vet. Akad. Förh. 1900, p. 1135).

The prolegs are situated on the 3rd to 6th abdominal segments and the last segment bears a pair of anal-prolegs. The forelegs are brownish:

In the living larva the colour on the anterior third is light yellow and backwards the colour evenly changes to light-red.

A pair of pupae, which were found together with the larvae, are ca. 9 mm. long, brownish, slender and quite without spines or appendages.

1. **Colias hecla** Lefbr.

A number of specimens from July and beginning of August.

2. **Argynnis chariclea** var. **arctica** Zett.

Many specimens from the end of June and into July.

3. **A. polaris** Bois.

This species seems to be just as common as the preceding; its time of flight is from the end of June on into August.

4. **Lycaena orbitulus** var. **aquilo** Bois.

More rare than the three foregoing butterflies; flies in July.

5. **Dasychira groenlandica** Woche.

Many larvae have been brought home; they were taken on willows and *Dryas*. The larvæ are seen in the end of May and the cocoons, full-grown larvae and pupae were found at the end of June and half-grown larvae were also found at the same time, so that AURIVILLIUS is right in his view, that the generation of this species takes more than one year. On a cocoon found on July 8th a clump of *Dasychira* eggs was found deposited.

6. **Anarta Richardsonii** Curt.

A number of specimens from the end of June till on in August. Some larvae were brought home; one, which was not full-grown, was found hibernating under *Dryas* on May 3rd 1907 and full-grown larvae were collected in June of the same year.

The larva reaches a length of 3 cm. The head is brown, the clypeus and the antennae darker; the dorsal plate on the 1st thoracic segment brown with dark marbling. The upper surface of the body dark brownish with a broad, light dorsal line, which is divided in the middle by one or two continuous, fine, dark lines. The sides and the under surface light brownish.

7. **Anarta lapponica** Thunb.

Two specimens from the beginning of July. To this species probably belongs another Noctuid larva which was found under *Dryas* on May 19th 1907.

The length of the larva is ca. 15—20 mm. The head is black;

the dorsal plate of the 1st thoracic segment brown with black marbling. The upper side grayish brown with a broad, light dorsal stripe, which is divided by a narrow, darker stripe, anteriorly cleft into two. On the sides there is a broad, white stripe; the under surface light brownish.

8. **Anarta Zetterstedtii** var. **Kolthoffii** Auriv.

One specimen; end of July 1907.

9. **Cidaria polata** Dup.

Several specimens from the middle of June to on in August.

A not yet full-grown larva was found on *Dryas*, June 15th 1907. The length of the larva is ca. 8 mm. The head is dark brown with outflowing darker small spots. The abdominal segments somewhat behind their front margin with two black oblique stripes which are broadest anteriorly and form an acute angle with each other, being continued back to the posterior margin of the segment. The area within the stripes white with indistinct brownish longitudinal striping. The last segment with a broad, black median line. The two last thoracic segments posteriorly with faint markings like those on the abdominal segments. Along the sides there is a narrow white line. The under surface and the legs dark grayish brown.

10. **Sericoris Schultziana** Fabr.

Two specimens from July and August.

11. **Penthina groenlandicana** Bang Haas.

A number of specimens from June and July. The species flies on dry, sunny places with *Cassiope* vegetation.

12. **Botys torvalis** Möschl.

Several specimens from the end of June and July.

Neuroptera.

Apatania arctica Boh.[1]

Five specimens, all females; July and beginning of August.

This species is the only representative hitherto known in East Greenland of the Order *Neuroptera*; on the west coast we have five species in addition to *Apatania*.

Hemiptera.

1. **Nysius groenlandicus** Zett.

A number of specimens, larvae and imagines, were taken together on July 31 1907 and on July 15th 1908. The species had hitherto

[1] The determination of this species is due to Mr. Esben Petersen, Silkeborg.

not been found in East Greenland; on the other hand, it is common in West Greenland.

2. **Chlamydatus pulicarius** Fall.

Some small Hemiptera larvæ, which probably belong to this species were found on *Potentilla* June—July.

3. **Aphis** sp.

A single specimen of a small leaf-louse, which contained a parasitic wasp, was found, as mentioned already, attached to a stone. Beside these some green apterous Aphidæ were found on an *Epilobium* 5/7 08.

Siphunculata.

Haematopinus trichechi Boh.

In August 1906 a walrus was shot and the flesh cut up to serve as food for the dogs in winter; when the skin was brought out to be used in the spring of 1907, a score of living specimens of *H. trichechi* were found in the inner part of the nipples.

EXPLANATION OF THE FIGURES.

Plate VII.

Fig. 1. *Tipula arctica. Larva.* The front part of the head from above. *a* antennae, *b* sense-process, *c* sense-organ, *d* chitinous ridge, *e* bristles.
— 2. — — — Mandible. a prostheca.
— 3. — — — Maxillary palp. *a* sense-process, *b* sense-organ.
— 4. — — — Ectolabium.
— 5. — — — Endolabium.
— 6. — — — Hind end.
— 7. — — *Pupa.*
— 8. *Culex nigripes. Larva.* The head.

Plate VIII.

— 9. *Culex nigripes. Larva.* The two last segments.
— 10. — — — Spinous row from the under side of the air-tube.
— 11. *Peteina stylata.* Larva in 3rd stage. Mouth-hooks and pharyngeal skeleton. *a* mouth-hooks, *b* the anterior pharyngeal plates, *c* the upper pharyngeal plates, *d* the lower.
— 12. — — Anterior spiracle.
— 13. — — Posterior spiracle.
— 14. Undetermined lepidopterous larva.

17—1—1910.

Fig. 1—7. *Tipula arctica.* Fig. 8. *Culex nigripes.*

J. C. N. del.

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11.

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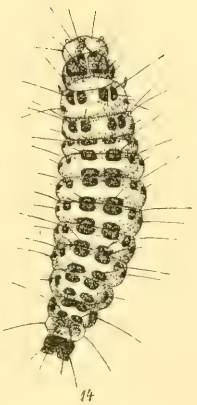

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10.

Fig. 9—10. *Culex nigripes.* Fig. 11—13. *Peteina stylata.*
Fig. 14. Undetermined lipidopterous larva.

9—13 J. C. N. del. 14 Dansk Repr. Anst.

III.

FRESHWATER ALGÆ FROM THE "DANMARK-EXPEDITION" TO NORTH-EAST GREENLAND (N. OF 76° N. LAT.)

BY

F. BØRGESEN

1910

INTRODUCTION.

Our knowledge of the Freshwater Algæ of East Greenland is based so far as I know upon the following papers:

Robert Boldt, Desmidieer från Grönland (1888).
— Några Söttvattensalger från Grönland (1893).
F. Borgesen, Ferskvandsalger fra Østgrønland (1894).
E. Larsen, The Freshwater Algæ of East Greenland (1904).

The first-mentioned paper deals, as is already shown in the title, only with Desmids and these originate from the whole of Greenland; from East Greenland 44 species are reported; they are found in the collections of A. G. Nathorst and J. A. Berlin from "Kung Oskars hamn" near Angmagsalik, 65° 31′ N. Lat.

In the second paper, on the other hand, Boldt deals with several freshwater algæ belonging to other groups which he had found on studying the Desmids in the above-mentioned collections. He mentions 4 species from East Greenland, all from the same locality.

In my paper, based upon material collected by N. Hartz during the expedition to East Greenland, 1891—92, are described a little more than 150 *Chlorophyceæ* and *Cyanophyceæ*; they were mostly gathered in the environs of "Hekla Havn" at "Danmarks Ø" in Scoresby Sound (ca. 70° 30′ N. Lat.); some of the material also originates from "Hold with Hope" in Hudson Land (ca. 73° 30′ N. Lat).

Finally, in Larsen's paper 125 *Chlorophyceæ* are mentioned. The material collected by Kruuse and N. Hartz comes from localities from Kap Dan (65° 31′ N. Lat.) up to Sabine Island (74° 30′ N. Lat.). In his paper Larsen brings together all the *Chlorophyceæ* hitherto known from East Greenland and they amount to 189 species in all; of these no less than 144 are Desmids.

The present list is based upon collections from the Danmark-Expedition to the North-east coast of Greenland in 1906—1908. They all originate from the district around Danmarks Havn, 76° 46′ N. Lat. and 18° 43′ W. Long., on Germania Land.

The material was collected by Mr. A. Lundager with exception of a single sample taken by Dr. Lindhard.

It consists of 20 samples preserved in spirit and 10 dried specimens. The localities from which the collections come are arranged from north to south in the following list.

Germania Land: —[1]
Rypefjeld.
Hvalrosodde,
Dove Bugt,
Lille Snenæs,
Snenæs,
Stormkap,
Vester Elv, } Danmarks Havn,
Basiskæret, }
Termometerfjeld,
Kap Bismarck,
Yderbugten,
} Between 77°—76° 43′ N. Lat. and 21°—17° 30′ W. Long.

In general the material collected may be regarded as rather poor, both as to quantity and quality. Certainly a few samples from "Vester Elv" (river) contained a great number of species but on the other hand the number of individuals was for most species very few; of several species I have only found one single specimen. This has made the determination decidedly troublesome.

The reason why the material upon the whole is so comparatively poor and the collections so small, often only consisting of a trifle at the bottom of the glass, of which even a great part was earth particles etc., is certainly that the manner of collecting was not the best one: a plankton-net was placed in running water and left there for several hours. In this way nearly all the Desmids named in the following list were collected and also several of the other species. Of course some bigger algæ e. g. *Nostoc* and clumps of algæ are collected along the sides of some lakes. On the other hand there are scarcely any collections made of small fixed algæ.

Judging from the really rather rich collections from Vester Elv gathered in this somewhat unpractical way I think it beyond doubt that a skilled algologist would be able to find a considerably greater number of species.

From this point of view I do not think it would be worth while to try and make a detailed comparison of the Freshwater alga flora from West Greenland and the surrounding lands with that of East Greenland. I shall restrict myself to pointing

[1] The localities here given are arranged from N. W. to S. E.

out the discovery of the genus *Spirotænia*, which up to the present had not been recorded from East Greenland or Greenland on the whole. The species found was *Sp. condensata* Bréb. which is well-known in arctic countries, e. g. in Nova Zembla and Spitzbergen.

Of high-arctic species hitherto not found in Greenland may be mentioned *Euastrum tetralobum* Nordst. which is known only from Spitzbergen and Nova Zembla.

Further may be named *Cosmarium spetsbergense* Nordst. also a true arctic species, which has earlier only once been found in East Greenland (Hurry Inlet); elsewhere it is only known from Jan Mayen, Spitzbergen and Nova Zembla.

Of the genera which I have mentioned in my above-mentioned paper, namely: *Mesotaenium* (1 species), *Penium* (5 species), *Cylindrocystis* (1 species), *Closterium* (6 species), *Pleurotænium* (1 species), *Cosmarium* (42 species), *Arthrodesmus* (2 species), *Xanthidium* (1 species), *Staurastrum* (29 species), *Euastrum* (6 species), *Gonatozygon* (1 species), *Desmidium* (1 species), *Gymnozyga* (1 species), *Hyalotheca* (1 species), *Sphaerozosma* (1 species) the following genera have not been discovered here: *Mesotaenium*, *Arthrodesmus*, *Xanthidium*, *Gonatozygon*, *Gymnozyga* and *Sphaerozosma*. Of *Closterium* only two species were present and of *Euastrum* 4 species only: 3 of the 6 species mentioned in my earlier paper have disappeared but in return the quite arctic species *Euastrum tetralobum* has been added and this confirms the fact first pointed out by Boldt, later by me, that the large *Euastrum*-species are wanting in the true arctic regions; the interesting find of *E. oblongum* in Jameson Land by Larsen makes this species an exception.

With regard to the most of the above-named genera the complete disappearance of some and the reduction in the number of species of others is in good accordance with what we know about the distribution of the plants in question, which all disappear or are very seldom in the arctic regions[1].

The remaining green algæ are of little interest. Of bluish-green algæ *Nostoc commune* seems to be common. Even very large specimens are found along the border of lakes or on places quite laid dry in summer. Stones on the bottom of lakes when dry were found covered by blackish crusts of different bluish-green algæ e. g. *Glœocapsa*-species and *Calothrix* etc.

No material of snow-algæ was brought home.

[1] Robert Boldt, Grunddragen af Desmidieernas Utbredning i Norden (Bihang till k. svenska Vet.-Akad. Handl. Bd. 13, Afd. III, No. 6, Stockholm 1887).

List of papers most referred to.

Boldt, Robert, Desmidieer från Grönland. — Bih. Sv. Vet. Akad. Handl. Bd. 13, Afd. III, Nr. 5, Stockholm 1888.

— Några sötvattens-alger från Grønland. — Bot. Notiser, 1893, Lund.

Borgesen, F., Ferskvandsalger fra Østgrønland. — Medd. om Grønland, XVIII, Kjøbenhavn 1894.

— Algues d'eau douce (C. Ostenfeld-Hansen, Contribution à la flore de l'île Jan Mayen). — Bot. Tidsskr. Bd. 21, Kjøbenhavn 1897.

Larsen, E., The Freshwater Algæ of East Greenland. Medd. om Grønland, XXX. København 1904.

— Ferskvandsalger fra Vest-Grønland. — Medd. om Grønland, XXXIII. København 1907.

Nordstedt, O., Desmidiaceæ ex insulis Spetsbergensibus et Beeren Eiland in expeditionibus annorum 1868 et 1870 suecanis collectæ. — Öfvers. k. Vet. Akad. Förh. 1872. No. 6. Stockholm.

— Desmidieæ arctoæ. Öfvers. k. Vet. Akad. Förh. 1875. No. 6. Stockholm.

— Desmidieer samlade af Sv. Berggren under Nordenskiöld'ska expeditionen till Grönland 1870. — Öfvers. k. Vet. Akad. Förh. 1885. No. 3. Stockholm.

Wille, N., Ferskvandsalger fra Novaja Semlja samlede af Dr. F. Kjellman paa Nordenskiölds Expedition 1875 (Öfversigt af kongl. Vet.-Akam. Förhandl. 1879, No. 5, Stockholm).

Myxophyceæ.

Chroococcaceæ.

Chroococcus Näg.

1. **C. turgidus** (Kütz.) Näg., Gattung. einz. Algen, p. 46.

Børgesen, Ferskvandsalg. Østgrønland, p. 6 (Hekla Havn, Gaasefjord).

Found in two collections, one from a bog, the other from a small lake.

Loc. Hvalrosodde: Lomsøen, Rypefjeld.

Gloeocapsa Näg.

1. **G. ambigua** Näg., Gattung. einz. Algen, p. 50.

Børgesen, Ferskvandsalg. Østgrønland, p. 6.

Found together with other bluish-green algæ in blackish crusts upon stones from the bottom of a dry mountain-lake.

Loc. Lille Snenæs.

2. **G. ianthina** Kütz. Nägeli, Gattung. einz. Algen, p. 51.

Børgesen, Ferskvandsalg. Østgrønland, p. 6.

Found together with the above-mentioned species under similar conditions.

Loc. Lille Snenæs, Thermometer Fjeld.

3. **G. Magma** (Bréb.) Kütz., Tab. Phycol. I, tab. 22, fig. 1.

Børgesen, Ferskvandsalg. Østgrønland, p. 6.

Found among other Algæ (*Nostoc* etc.) and Musci near the foot of a glacier and in blackish incrustations on stones.

Loc. Lille Snenæs, Thermometerfjeld.

Coelosphaerium Näg.

1. **C. lacustre** (Chodat) Ostenf., Beitr. z. Kenntnis d. Algenflora des Kossogol-Beckens (Hedwigia, Bd. 46. p. 396, tab. IX, fig. 6—7).

The pear-shaped cells in the colony were somewhat closer together than in the figure of Ostenfeld.

Lat. cell. = 2,5 μ.

Dr. Ostenfeld has most kindly seen the plant in question and told me that it seems to him identical with this species.

Found in a collection from Vester Elv.

Loc. Danmarks Havn.

Merismopedium Meyen.

1. **M. glaucum** (Ehrb.) Näg., Gattung. einz. Algen, p. 55.

Børgesen, Ferskvandsalg. Østgrønland, p. 7 (Hekla Havn).

A few specimens were found in collections from Vester Elv.

Loc. Danmarks Havn.

Oscillariaceæ.

Phormidium Kütz.

1. **Ph. autumnale** (Ag.) Gom., Monograph. Oscill. p. 207, tab. V, fig. 23—24.

Børgesen, Ferskvandsalg. Østgrønl., p. 7 (Hekla Havn).

Found as blackish crusts among other algæ and mosses on wet earth near a glacier.

Loc. Thermometerfjeld.

Rivulariaceæ.

Calothrix Ag.

C. parietina (Näg.) Thur., Bornet et Flahault, Revision des Nostoc. héter. I, p. 366.

Found together with *Gloeocapsa*-species as blackish crusts on stones from the bottom of a dry mountain lake.

This species was not earlier found in East Greenland but in West Greenland it is known from Karajak (RICHTER, Süsswasseralgen aus dem Umanakdistrikt, p. 4).

Loc. Lille Snenæs.

Scytonemaceæ.

Scytonema Ag.

1. Sc. Myochrous (Dillw.) Ag., Bornet et Flah., Revision des Nostoc. hétérocyst. p. 104.

Børgesen, Ferskvandsalger. Østgrønland, p. 8.

A few filaments most probably belonging to this species were found in a small lake.

Loc. Hvalrosodde: Lomsøen.

Tolypothrix Kütz.

1. T. lanata (Desv.) Wartm. Bornet et Flahault, Revision des Nostoc. hétérocyst., p. 120.

Børgesen, Ferskvandsalg. Østgrønl., p. 8 (Hekla Havn).

The filaments were a little thicker than the measurements given by BORNET et FLAHAULT, l. c., namely 10—14 μ. But after having examined specimens referred by BORNET et FLAHAULT to this species, e. g. No. 184 in WITTROCK & NORDSTEDT, Algæ Exsicc., I have also here found filaments reaching this thickness and I have therefore no doubt as to the correctness of the determination.

Found in small lakes.

Loc. Hvalrosodde: Lomsøen.

Nostocaceæ.

Nostoc Vauch.

1. N. commune Vauch. Bornet et Flahault, Revision des Nostoc. hétérocyst. p. 203.

Børgesen, Ferskvandsalg. Østgrønl. p. 8.

This species seems to be common. It is found partly in the form of a large gelatinous membrane, partly also as more crumpled masses.

It occured in bogs and also in places laid dry.

Loc. Basiskæret, Stormkap, Kap Bismarck, Rypefjeld.

Young small colonies of *Nostoc* were found in several collections. They were e. g. common as blackish crusts, composed of fragments of Algæ and Musci etc. on ground near the foot of a glacier at "Thermometerfjeld" and on damp ground at "Yderbugten".

Conjugata.

Desmidiaceæ.

Penium Bréb.; De Bar.

1. **P. Libellula** (Focke) Nordst., Desm. Bornh. p. 184. *Penium closteroides* Ralfs, Børgesen, Ferskvandsalg. Østgrønland, p. 9, tab. 1, fig. 1.

Boldt, Desm. Grønland, p. 40 (sub. nom. *Penium closteroides*) (Kung Oskars hamn).
Børgesen, Ferskvandsalg. Østgrønland, p. 9 (Hekla Havn).

Long. = 70—80 μ; lat. = 17 μ.

A single specimen seen in a collection from "Vester Elv".

Loc. Danmarks Havn.

2. **P. margaritaceum** (Ehrenb.) Bréb., Ralfs, Brit. Desm. p. 149, tab. 25, fig. 1; tab. 33, fig. 3.

Børgesen, Ferskvandsalg. Østgrønland, p. 9 (Hekla Havn).
Larsen, Freshw. Alg. East Greenl. p. 94 (Kordlortok, Amaka, Kap Dalton, Jameson Land, Sabine Ø).

Lat. = 25 μ.

Found in two collections from "Vester Elv".

Loc. Danmarks Havn.

3. **P. curtum** Bréb., in Kütz Spec. Alg. p. 167. *Cosmarium curtum* Ralfs, Brit. Desm. p. 109, tab. 32, fig. 9. *Dysphinctium* (*Actinotaenium*) *Regelianum* Näg., Gatt. einz. Alg. p. 110, tab. VI E.

Børgesen, Ferskvandsalg. Østgrønland. p. 9, 10 (Hekla Havn, Hold with Hope).
Larsen, Freshw. Alg. East Greenl., p. 94 (Kap Dalton, Jameson Land, Kap Borlase Warren, Sabine Ø).

The specimens found quite agreed in size with those I have mentioned in my earlier paper (l. c.).

Long. = 43 μ; lat. = 22 μ.

Loc. Danmarks Havn: Vester Elv.

Cylindrocystis Menegh.

1. **C. Brebissonii** (Menegh.) De Bary, Conjug. p. 35, tab. 7, fig. E 1—22.

Børgesen, Ferskvandsalg. Østgrønland, p. 10 (Gaasefjorden).
Larsen, Freshw. Alg. East Greenl. p. 90 (Kingorsuak, Kap Dalton).

Some few specimens were seen in a collection from "Vester Elv".

Lat. = 15 μ.

Loc. Danmarks Havn.

Spirotænia Bréb.

1. **Sp. condensata** Bréb. in Ralfs, Brit. Desm. p. 179, tab. 34, fig. 1.

Long. = 90 μ; lat. = 17 μ.

The size of the plant corresponds closely with that Nordstedt gives for the plant found at Mosel Bay in Spitzbergen (Nordst., Desm. arct. p. 15) but it is much smaller than the size West gives for the plant in his Monograph of the British Desmidiaceæ, vol. I, p. 38.

This species has not earlier been found in East Greenland and it is also not mentioned from West Greenland (cfr. Larsen, II). Only found in few specimens in Vester Elv.

Loc. Danmarks Havn.

Closterium Nitzsch.

1. **Cl. acutum** (Lyngb.) Bréb., in Ralfs' Brit. Desm., p. 177, tab. 30, fig. 5.

Børgesen, Ferskvandsalg., Østgrønland, p. 10 (Hekla Havn).
Larsen, Freshw. Alg. East Greenl. p. 81 (Kordlortok, Liverpool Kyst in Hurry Inlet).

Loc. Danmarks Havn. Only a few specimens found in Vester Elv.

Lat. cell. = 11 μ.

2. **Cl. striolatum** Ehrenb., Entw. d. Inf. p. 68. Ralfs, Brit. Desm., p. 170, tab. 29, fig. 2.

Boldt, Desm. Grønl. p. 42 (Kung Oskars hamn).
Børgesen, Ferskvandsalg. Østgrønland, p. 10 (Hekla Havn, Røde Ø).
Larsen, Freshw. Alg. East Greenl., p. 82 (Amaka, Liverpool Kyst in Hurry Inlet).

Only a single specimen was found, the breadth of which was 50 μ.

Loc. Danmarks Havn: Vester Elv.

Pleurotænium Näg.

1. **P. truncatum** (Bréb.) Näg., Gatt. einz. Alg., p. 104.

Only a single specimen found in a collection from Vester Elv.

Long. = 400 μ; lat. = 54 μ.

In size it agrees very well with the measurements given by Nordstedt for plants found in Spitzbergen and Bear Island (Nordstedt, Desm. Spetsb. p. 26).

This species was not earlier recorded from East Greenland but it is known from West Greenland (Larsen, II, p. 346).

Loc. Danmarks Havn.

Tetmemorus Ralfs.

1. **T. lævis** (Kütz.) Ralfs, Brit. Desm. p. 146, tab. 24, fig. 3.

β **attenuatus** Wille, Ferskvandsalg. Nov. Semlja, p. 58, tab. 14, fig. 77.

Boldt, Desm. Grønl. p. 42 (Kung Oskars hamn).
Larsen, Freshw. Alg. East Greenl. p. 101 (Amaka Kap Dalton).

Only one half-cell was found; the cell-membrane was minutely punctate.

Lat. cell. = 28 μ.

Loc. Danmarks Havn: Vester Elv.

Cosmarium (Corda) Ralfs.

1. **C. bioculatum** Bréb., in Ralfs, Brit. Desm. p. 95, tab. 15, fig. 5.

Boldt, Desm. Grønl., p. 16 (Kung Oskars hamn).
Børgesen, Ferkvandsalg. Østgrønland, p. 18 (Røde Ø, Hekla Havn).
Larsen, Freshw. Alg. East Greenland, p. 88 (Kap Borlase Warren. Sabine Ø).

A form agreeing well with that mentioned by Nordstedt, Desm. arct., p. 20, tab. 6, fig. 8 was found in Vester Elv.

Long. = 29 μ; lat. = 27 μ; lat. isthm. 9 μ.

Loc. Danmarks Land.

2. **C. Botrytis** (Bory) Menegh., Synops. Desm. p. 220.

Boldt, Desm. Grønl., p. 28 (Kung Oskars hamn).
Børgesen, Ferskvandsalg. Østgrønland, p. 13 (Hekla Havn, Danmarks Ø).
Larsen, Freshw. Alg. East Greenland, p. 83 in several localities from Kordlortok (65° 40′)—Kap Borlase Warren (74° 1′).

Some few specimens were found in collections from Vester Elv.

Loc. Danmarks Havn.

3. **C. conspersum** Ralfs, Brit. Desm., p. 101, tab. 16, fig. 4.

β **rotundatum** Wittr., Skandin. Desm., p. 13, tab. I, fig. 4.

Børgesen, Ferskvandsalg. Østgrønland, p. 13 (Hekla Havn, Røde Ø).
Larsen, Freshw. Alg. East Greenland, p. 84 (Jameson Land, Kap Borlase Warren).

A form rather near that mentioned by Boldt (Desm. Grønl. p. 26, tab. 2, fig. 27) was found in a small lake at Hvalrosodde.

Long. = 80 μ; lat. = 65 μ; lat. isthm. = 24 μ; crass. = 39 μ.

Loc. Hvalrosodde.

4. **C. crenatum** Ralfs, Ann. Nat. Hist., vol. 14, p. 394, tab. 11, fig. 6; Brit. Desm., p. 96, tab. 15, fig. 7.

Boldt. Desm. Grønl., p. 18 (Kung Oskars hamn).
Børgesen, Ferskvandsalg. Østgrønland, p. 14 (Hekla Havn).

Forma "**Crenæ laterales** 3", Nordstedt, Desm. Spetsberg. p. 30, tab. 6, fig. 7.

One specimen was found in Vester Elv.

* **costatum** Nordstedt, Desm. Spetsberg, p. 30, tab. 6, fig. 9.

Long. = 41 μ.

Found in the same locality.

Loc. Danmarks Havn.

5. **C. cyclicum** Lund., Desm. Suec., p. 35, tab. 3, fig. 6.

* **arcticum** Nordst., Desm. Spetsb., p. 31, tab. 6, fig. 13.

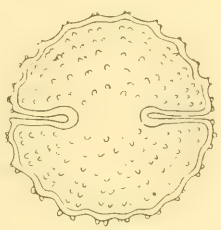


Fig. 1. *C. cyclicum* Lund. **arcticum* Nordst. ($^{270}/_{1}$).

Børgesen, Ferskvandsalg. Østgrønland, p. 15 (Hekla Havn).
Larsen, Freshw. Alg. East Greenl. p. 84 (Amaka, Falkefjæld, Kingorsuak, Kap Dalton, Liverpool Kyst in Hurry Inlet, Sabine Ø).

This species was absolutely the most common in the collections

and the only one of which I have seen a great number of specimens. It seems to be rather variable as to size and form of the cell. Most of the individuals seen quite agreed with the above-cited figure of Nordstedt, the cells being quite circular.

Long. = 62 μ = lat.

Other specimens were more hexagonal, coming near to the form which Boldt in Desm. Grønl., p. 23, tab. I, fig. 24 has called var. *subarcticum*.

Long. = 67 μ; lat. = 70 μ.

This variety seems to come rather near to *Cosm. Nordstedtianum* Reinsch, which Nordstedt in "Hedwigia", 1876 has referred as a form to *Cosm. cyclicum* (cfr. W. West and G. S. West, Monogr. of the Brit. Desm., vol. II, p. 146, pl. LVIII, fig. 12).

Loc. Danmarks Havn: Vester Elv.

6. **C. Debaryi** Arch. in Pritch. Infus., p. 735.

Børgesen, Ferskvandsalg. Østgrønland, p. 21 (Hekla Havn).

β **Novæ Semliæ** Wille, Ferskvandsalg. Nov. Semlja, p. 48.

The form observed seems to agree quite well with forma *minor* Wille, l. c. tab. XIII, fig. 47; but as I have only found a single specimen without chlorophyll I may mention that the determination is not at all certain. Perhaps we have to do with a form of *C. Cucumis* Ralfs (cfr. Nordstedt, Desm. arct. p. 29, tab. VIII, fig. 28, 29) or with a big form of *C. quadratum* Ralfs.

Long. = 90 μ; lat. = 47 μ; lat. isthm. 31 μ.

The specimen was found in Vester Elv.

Loc. Danmarks Havn.

7. **C. granatum** Bréb. in Ralfs, Brit. Desm. p. 96, tab. 32, fig. 6.

Boldt, Desm. Grønl. p. 12 (Kung Oskars hamn).

Børgesen, Ferskvandsalg. Østgrønland, p. 18 (Hekla Havn).

Larsen, Freshw. Alg. East Greenl. p. 85 (Kordlortok, Amaka).

Loc. Hvalrosodde.

8. **C. hexalobum** Nordst., Desm. Spetsb., p. 33, tab. VII, fig. 16.

Børgesen, Ferskvandsalg. Østgrønland, p. 15 (Hekla Havn).

Larsen, Freshw. Alg. East. Greenl. p. 85 (Kap Dalton, Liverpool Kyst in Hurry Inlet).

Fig. 2. *C. hexalobum* Nordst. ($^{270}/_{1}$.)

This arctic and alpine species has been found in several collections from Vester Elv. The form observed (Fig. 2) agreed rather well with Nordstedt's description, the only difference being that it was not quite so broad. Boldt in Desm. Grønl. p. 24 has also mentioned such a narrow form.

Long. = 54 μ; lat. = 37 μ; lat. isthm. = 14.

Loc. Danmarks Havn.

9. **C. Holmiense** Lund., Dem. Suec., p. 49, tab. 2, fig. 20.

β **integrum** Lund., Nordst. Desm. Spetsb., pag. 28, tab. 6, fig. 5.

Børgesen, Ferskvandsalg. Østgrønland, p. 20 (Hekla Havn, Røde Ø, Hold with Hope).

Larsen, Freshw. Alg. East Grenl. p. 85 in diflerent localities from Kingorsuak (60° 5′) to Sabine Ø (74° 30′).

A few specimens were found in Vester Elv.

Long. = 58 *μ*; lat. = 30 *μ*.

Loc. Danmarks Havn.

10. **C. Meneghinii** Bréb.

Børgesen, Ferskvandsalg. Østgrønland, p. 16 (Hekla Havn, Røde Ø).

Larsen, Freshw. Alg. East Greenl., p. 86 (found in several localities from Kordlortok 65° 40′—Sabine Ø 74° 30′).

Forma De Bary, Conjugaten, p. 72, tab. 6, fig. 34.

Found once in a small lake.

Loc. Hvalrosodde.

11. **C. microsphinctum** Nordst., Desm. Ital. p. 33, tab. 12, fig. 9.

Børgesen, Ferskvandsalg. Østgrønland, p. 16, tab. 1, fig. 6.

Larsen, Freshw. Alg. East Greenl., p. 86 (Kap Dalton, Sabine Ø).

The observed form quite agreed with that mentioned and figured in my above-quoted paper. I propose to call it f. *groenlandica*.

Long. = 48 *μ*; lat. = 32 *μ*; lat. isthm. = 20 *μ*.

Found once in Vester Elv.

Loc. Danmarks Havn.

12. **C. nasutum** Nordst., Desm. Spetsb. p. 33, tab. VII, fig. 17.

Forma **granulata** Nordst., l. c. p. 34, Wille, Ferskv. Alg. Nov. Semlja. p. 42, tab. XII, fig. 30.

Børgesen, Ferskvandsalg. Østgrønland, p. 14 (Hekla Havn).

Larsen, Freshw. Alg. East Greenl. p. 86 (Kordlortok, Kap Dalton, Liverpool Kyst in Harry Inlet).

The form observed was in good accordance with the above-mentioned figure by Wille.

Long. = 40 *μ*; lat. = 32 *μ*.

It was found in two collections from Vester Elv.

Loc. Danmarks Havn.

13. **C. ochtodes** Nordst., Desm. arctoæ, p. 17, tab. VI, fig. 3.

Boldt, Desm, Grønl. p. 29 (Kung Oskars hamn).

Børgesen, Ferskvandsalg. Østgrønland, p. 13 (Hekla Havn).

Larsen, Freshw. Alg. East Greenl. p. 87 (in several localities from Kordlortok 65° 40′ to Sabine Ø 74° 30′).

Found in several collections from Vester Elv.

Long. = 88 *μ*; lat. 59 *μ*.

Loc. Danmarks Havn.

14. **C. pseudoprotuberans** Kirchner, Alg. Schles. p. 150.

Børgesen, Ferskvandsalg. Østgrønland, p. 18, tab. I, fig. 12 (Hekla Havn).
Larsen, Freshw. Alg. East Greenl., p. 88 (Amaka).

Forma *isthmo latiore* Børgs. l. c.

A few specimens like this form were found in Vester Elv.

Long. = 38 μ; lat. = 30.

Loc. Danmarks Havn.

15. **C. pulcherrimum** Nordst., Desm. Brasil., p. 213, tab. 3, fig. 24.

β **boreale** Nordst., Desm. Spetsb. p. 32, tab. 6, fig. 14.

A few specimens were found in collections from Vester Elv and Lille Snenæs.

Long. = 54 μ; lat. = 39 μ.

Loc. Danmarks Havn, Lille Snenæs.

16. **C. quadratum** Ralfs in Ann. Mag. Nat. Hist. p. 395, tab. 11, fig. 9; Brit. Desm., p. 92, tab. 15, fig. 1 a.

Boldt, Desm. Grønl., p. 10 (Kung Oskars hamn).
Børgesen, Ferskvandsalg. Østgrønland, p. 20 (Hekla Havn, Røde Ø).
Larsen, Freshw. Alg. East Greenl. p. 88 (in several localities from Kordlortok 65° 40′ to Sabine Ø 74° 30′).

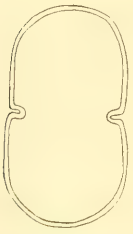


Fig. 3. *C. quadratum* Ralfs, forma *Willei* West ($^{350}/_{1}$).

Forma *Willei* West, Monograph. Brit. Desm., vol. III, p. 59, C. quadratum Ralfs forma "Semicellulæ lateribus nonnumquam latissime rotundatis l. rectis, nec retusis" Wille, Ferskvandsalg. Nov. Semlja, p. 37, tab. XII, fig. 20 et forma "major" ibidem fig. 21.

The form found had a somewhat thinner membrane than WILLE's. (Fig. 3). Compare "Forma semicellula in apice magis rotundata quam in forma typica", Borge, Sib. Chlorophyllophycé-Flora, p. 12, fig. 6.

Long. = 57—67 μ; lat. = 35—38 μ; lat. isthm. = 28 μ.

Loc. Vester Elv, Hvalrosodde.

17. **C. reniforme** (Ralfs) Archer in Journ. of Bot. 1874, p. 92. Cosm. margaritiferum Menegh. var. reniformis Ralfs, Brit. Desm. p. 100, tab. 16, fig. 2 a.

Børgesen, Ferskvandsalg. Østgrønland, p. 13 (Hekla Havn).

A few specimens of this species were found in Vester Elv.

Long. = 50 μ; lat. = 47 μ.

Loc. Danmarks Havn.

18. **C. speciosum** Lund., Desm. Suec. p. 34, tab. III, fig. 5.

var. **biforme** Nordst., Desm. Spetsb. p. 30, tab. VI, fig. 11.

Boldt, Desm. Grønl., p. 20 (Kung Oskars hamn).
Børgesen, Ferskvandsalg. Østgrønland, p. 15 (Røde Ø).
Larsen, Freshw. Alg. East Greenl., p. 88 (Sabine Ø).

Specimens agreeing very well with NORDSTEDT's description and figure were found in two collections from Vester Elv.

Long. = 62—65 μ; lat. = 40—47 μ.

Loc. Danmarks Havn.

19. **C. spetsbergense** Nordst., Desm. Spetsb., p. 27, tab. 6, fig. 3.

Larsen, Freshw. Alg. East Greenl. p. 89 (Liverpool Kyst in Hurry Inlet).

This arctic species hitherto only known from Jan Mayen, Spitzbergen, Nova Zembla and the above mentioned locality in East Greenland has been found in two collections from Vester Elv.

Long. = 61 μ, lat. = 32 μ.

Loc. Danmarks Havn.

20. **C. subcrenatum** Hantzsch. in Rabenh. Alg. No. 1213; Nordstedt, Desm. arct., p. 21. tab. 6, fig. 10—11.

Boldt, Desm. Grønl. p. 18 (Kung Oskars hamn).

Børgesen, Ferskvandsalg. Østgrønland, p. 14 (Hekla Havn).

Larsen, Freshw. Alg. East Greenl., p. 89 (in several localities from Kordlortok 65° 40′ to Sabine Ø 74° 30′).

Long. = 32 μ; lat. = 29 μ.

Loc. Found in two collections from Vester Elv.

21. **C. subspeciosum** Nordst., Desm. arct. p. 22, tab. 6, fig. 13.

Børgesen, Ferskvandsalg. Østgrønland, p. 16.

A form agreeing very well with the description and figure of NORDSTEDT was found in a collection from Lille Snenæs.

Long. = 42 μ; lat. = 30 μ.

A zygospore was found of this species (Fig. 4). This was globose, furnished with rather long furcate-emarginate spines, each of which arises from a broadly conical base provided with teeth.

Lat. zygosp. cum. spin. = 54 μ.

Lat. zygosp. sine spin. = 40 μ.

Loc. Lille Snenæs.

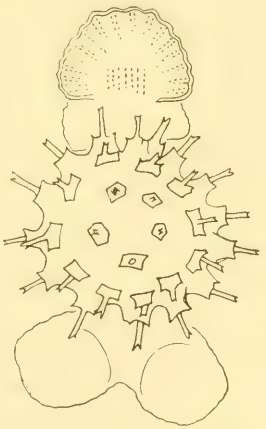


Fig. 4. *C. subspeciosum* Nordst. A Zygospore. ($^{350}/_{1}$.)

22. **C. Turpinii** Bréb., Liste Desm., p. 127, tab. 1, fig. 11.

Boldt, Desm. Grønl., p. 24 (Kung Oskars hamn).

Børgesen, Ferskvandsalg. Østgrønland, p. 13, tab. 1, fig. 7 (Hekla Havn).

Larsen, Freshw. Alg. East Greenl., p. 90 (in several localites from Kordlortok 65° 40′ to Sabine Ø 74° 30′).

The specimens found agreed very well with the form (forma *gallica* Lund.) mentioned in my earlier paper.

Long. = 62 μ; lat. = 54 μ.

Loc. Danmarks Havn: Vester Elv.

Euastrum Ehrenb., Ralfs.

1. **E. binale** (Turp.) Ehrenb., Berlin. Monatsber. 1840, p. 208. Ralfs, Brit. Desm., p. 90, tab. 14, fig. 8 (partim).

Boldt, Desm. Grønl., p. 8 (Kung Oskars hamn).

Børgesen, Ferskvandsalg. Østgrønland. p. 31 (Danmarks Ø, Gaasefjord, Hekla Havn).

Larsen, Freshw. Alg. East Greenl., p. 91 (in several localities from Kordlortok 65° 40 to Sabine Ø 74° 30′).

Forms like RALF's fig. 8 b and e were found in collections from Vester Elv.

Long. = 22 μ.

subspec. **dissimile** Nordst., Desm. arct. p. 31, tab. VIII, fig. 31.

Found in a gathering from the same locality.

Long. = 28 μ; lat. = 20 μ.

Loc. Danmarks Havn.

Fig. 5. *E. cuneatum* Jenner. Forma. ($^{350}/_{1}$).

2. **E. cuneatum** Jenner in Ralfs, Brit. Desm., p. 90, tab. 32, fig. 3 a.

Boldt, Desm. Grønl., p. 7 (Kung Oskars hamn).

Børgesen, Ferskvandsalg. Østgrønland, p. 31 (Hekla Havn).

The form found (Fig. 5) was somewhat smaller than the typical form and had somewhat narrower apices. It seems to come rather near the form mentioned by RACIBORSKI in Nowe Desmidyje, p. 30, tab. VI, fig. 8. Cfr. also BOLDT, l. c. p. 7, tab. 1, fig. 7.

Long. = 86 μ; lat. = 42 μ.

Only a few specimens were found in two collections from Vester Elv.

Loc. Danmarks Havn.

3. **E. elegans** (Bréb.) Kütz., Phycol. germ., p. 135; Ralfs, Brit. Desm., p. 89, tab. 14, fig. 7 a—d.

Boldt, Desm. Grønl. p. 9 (Kung Oskars hamn).

Børgesen, Ferskvandsalg. Østgrønland, p. 31 (Hekla Havn).

Larsen, Freshw. Alg. East Greenl. p. 91 (in several localities from Kordlortok 65° 40′ to Sabine Ø 74° 31′).

Forms like RALFS fig. 7 a and b (l. c.) were found in Vester Elv and a small lake at Hvalrosodde.

Loc. Danmarks Havn, Hvalrosodde.

4. **E. tetralobum** Nordst., Desm. arct. p. 30, tab. VIII, fig. 30.

This characteristic and, it seems, true arctic species was not earlier known from East Greenland. Hitherto it was only known from Spitzbergen and Nova Zembla.

The form observed quite agreed with the figure and description of NORDSTEDT.

Long. = 89 μ; lat. = 64 μ.

It was found in several collections from Vester Elv.

Loc. Danmarks Havn.

Staurastrum Meyen.

1. **S. aculeatum** (Ehrenb.) Menegh., Desmidium aculeatum Ehrenb., Infus. p. 142, tab. 10, fig. 12. Ralfs, Brit. Desm., p. 142, tab. XXIII, fig. 2.

β **ornatum** Nordst., Desm. Spetsb. p. 40, tab. VII, fig. 27.

forma **spinossisima** Wille., Ferskvandsalg. Nov. Semlja, p. 54, tab. XIII, fig. 67—68.

Børgesen, Ferskvandsalg. Østgrønland, p. 28 (Hekla Havn).

Larsen, Freshw. Alg. East Greenl., p. 95 (Kap Dalton, Liverpool Kyst in Hurry Inlet).

Some few specimens of this variable species, coming near to the above-mentioned form of Wille, were found in several collections from Vester Elv.

Long. = 37 μ; lat. = 40 μ.

Loc. Danmarks Havn.

2. **S. avicula** Bréb. forma Boldt, Desm. Grønl. p. 37. Staur. denticulatum (Näg.) Archer forma Elfv. Anteckn. finska desm. p. 9, tab. 1, fig. 5.

A single specimen was found in a collection from Vester Elv.

Long. 29 μ; lat. sin. acul. = 35 μ.

It was not earlier found in East Greenland but the species is known from Godthaab (Larsen, l. c., p. 347) and Friedrichsthal (Boldt, l. c., p. 37) in West Greenland.

Loc. Danmarks Havn.

3. **S. Brebissonii** Archer in Pritch. Infus. p. 739.

forma **minor** Nordst., Desm. Grønl. p. 10.

Larsen, Freshw. Alg. East Greenl. p. 96 (Kordlortok, Amaka, Kap Dalton, Liverpool Kyst in Hurry Inlet, Jameson Land).

Found in several collections from Vester Elv.

Long. = 40—50 μ; lat. 35—40 μ.

Loc. Danmarks Havn.

4. **S. hexaceros** (Ehrenb.) Wittr., Gotl. Öl. sötv. Alg., p. 151.

forma **alternans** Wille, Ferskvandsalg. Nov. Semlja, p. 52, tab. XIII, fig. 63.

Børgesen, Ferskvandsalg. Østgrønland, p. 27 (Hekla Havn).

Larsen, Freshw. Alg. East Greenl., p. 97 (Jameson Land).

The form observed was a little larger than that mentioned by Wille (l. c.).

Long. = 31 μ.

Found in a collection from Vester Elv.

Loc. Danmarks Havn.

5. **S. lunatum** Ralfs, Brit. Desm., p. 124, tab. 34, fig. 12.

Forma **Groenlandica** Børgs. Ferskvandsalg. Østgrønland, p. 29, tab. 2, fig. 27.

Larsen, Freshw. Alg. East Greenl., p. 98 (Liverpool Kyst in Hurry Inlet).

Found in a collection from Vester Elv.

Lat. sin. spin. = 30 μ.

Loc. Danmarks Havn.

6. **S. meganolotum** Nordst., Desm. arctoæ, p. 35, tab. VIII, fig. 38.

Boldt, Desm. Grønl. p. 39 (Kung Oskars hamn).

Børgesen, Ferskvandsalg. Østgrønland, p. 28 (Hekla Havn).

Of this species I have found a form coming near to forma *Groenlandica* mentioned by me (l. c. p. 28, tab. 2, fig. 29). It was observed in a collection from Vester Elv.

Loc. Danmarks Havn.

7. **St. monticulosum** Bréb. in Chev. Micr. p. 272. Ralfs, Brit. Desm., p. 130, tab. 34, fig. 9.

β **bifarium** Nordst., Sydl. Norg. Desm. p. 31, fig. 14.

forma **Groenlandica** Børgs., Ferskvandsalg. Østgrønland, p. 29, tab. 2, fig. 25.

Larsen, Freshw. Alg. East Greenl., p. 98 (Jameson Land).

Found in collections from Vester Elv.

Long. = 40 μ; lat. = 38 μ.

Loc. Danmarks Havn.

8. **S. muticum** Bréb., Ralfs, Brit. Desm., p. 125, tab. 21, fig. 4; tab. 34, fig. 13.

Børgesen, Ferkvandsalg. Østgrønland, p. 24 (Hekla Havn).

Found in collections from Vester Elv.

Long. = 32—39 μ; lat. = 29—31 μ.

Loc. Danmarks Havn.

9. **S. orbiculare** (Ehrenb.) Menegh., Synops. Desm. p. 225. Ralfs, Brit. Desm. p. 125, tab. 21, fig. 5.

Børgesen, Ferskvandsalg. Østgrønland, p. 24 (Hekla Havn).

A form like Ralfs fig. 5 a was found once in a collection from Vester Elv.

Long. = 30 μ = lat.

Loc. Danmarks Havn.

10. **S. pachyrhynchum** Nordst., Desm. arctoæ, p. 30, tab. VIII, fig. 34.

Børgesen, Ferskvandsalg. Østgrønland, p. 24 (Hekla Havn, Røde Ø).

Larsen, Freshw. Alg. East Greenl. p. 99 (Amaka, Kap Dalton, Jameson Land. Sabine Ø).

forma *3-gona* Nordst. l. c.

forma *5-gona* Nordst. l. c.

This very variable species occurred rather commonly in several collections from Vester Elv.

Loc. Danmarks Havn.

11. **S. polymorphum** Bréb. in Ralfs, Brit. Desm. p. 135, tab. 22, fig. 9; tab. 34, fig. 6.

Boldt, Desm. Grønl., p. 38 (Kung Oskars hamn).

Børgesen, Ferskvandsalg. Østgrønland, p. 27 (Hekla Havn).

Larsen, Freshw. Alg. East Greenl., p. 99 (Kordlortok).

Found in collections from Vester Elv.

Long. = 42 μ = lat.

Loc. Danmarks Havn.

12. **S. punctulatum** Bréb. in Ralfs Brit. Desm., p. 133, tab. 22, fig. 1.

β **Kjellmani** Wille in Dijmphna Togt. vidensk. Udb. p. 86, St. Kjellmani Wille, Nov. Semlja, p. 50, tab. XIII, fig. 52.

Boldt, Desm. Grønl. p. 35 (Kung Oskars hamn).

Børgesen, Ferskvandsalg. Østgrønland, p. 26 (Hekla Havn).

Larsen, Freshw. Alg. East Greenl. p. 99 (Kap Dalton, Liverpool Kyst in Hurry Inlet, Sabine Ø).

A single specimen was found in Vester Elv.

Long. = 48 μ; lat. = 33 μ.

Loc. Danmarks Havn.

13. **S. pygmæum** Bréb. in Ralfs Brit. Desm., p. 213, tab. 35, fig. 26.

Boldt, Desm. Grønl., p. 34 (Kung Oskars hamn).

Børgesen, Ferskvandsalg. Østgrønl., p. 26 (Hekla Havn).

Larsen, Freshw. Alg. East Greenl. p. 99 (Amaka, Tunok, Kap Borlase Warren).

forma **major** Wille, Ferskvandsalg. Nov. Semlja, p. 51, tab. XIII. fig. 54.

Long. = 44 μ.

Found once in a collection from Vester Elv.

Loc. Danmarks Havn.

14. **S. Saxonicum** Bulnh. in Rab. Krypt. Fl. Sachs. p. 190.

Børgesen, Ferskvandsalg. Østgrønland, p. 27.

Found in a collection from Vester Elv.

Long. = 75 μ; lat. = 68 μ.

Loc. Danmarks Havn.

15. **S. teliferum** Ralfs, Brit. Desm. p. 128, tab. 22, fig. 4; tab. 34, fig. 14.

Børgesen, Ferskvandsalg. Østgrønland, p. 27 (Hekla Havn, Danmarks Ø).

Larsen, Freshw. Alg. East Greenl. p. 100 (Kordlortok, Amaka, Falkefjæld, Jameson Land).

var. **ordinata** Børgs. l. c. p. 27, tab. 2, fig. 23.

Lat. cell. sine spin. = 33 μ.

Found in collections from Vester Elv.

Loc. Danmarks Havn.

Hyalotheca Ehrenb.

1. **H. dissiliens** (Dillw.) Bréb. in Ralfs Brit. Desm. p. 51, tab. 1, fig. 1.

Boldt, Desm, Grønl. p. 43 (Kung Oskars hamn).

Børgesen, Ferskvandsalg. Østgrønland, p. 32 (Hekla Havn).

Larsen, Freshw. Alg. East Greenl. p. 93 (Falkefjeld, Jameson Land, Liverpool Kyst in Hurry Inlet, Sabine Ø).

This species seems to be rather common; var. *tridentula* Nordst. (Sydl. Norges Desm. p. 48, fig. 23) was found and most probably also other forms occurred.

Found in several collections from Vester Elv.

Loc. Danmarks Havn.

Desmidium Ag.

1. **D. Swartzii** Ag., Syst. Alg. p. 9. Ralfs, Brit. Desm., p. 61, tab. 4.

Børgesen, Ferskvandsalg. Østgrønland, p. 32 (Hekla Havn).

Larsen, Freshw. Alg. East Greenl., p. 90 (Kordlortok, Amaka).

Found in two collections from Vester Elv.

Loc. Danmarks Havn.

Zygnemaceæ.

Zygnema (Ag.) De Bary.

Z. spec.

Filaments of a sterile *Zygnema* were found rather richly in a collection from Vester Elv. A few of the filaments had rhizoids; perhaps we have to do with *Zygogonium ericetorum.*

Also in a collection from "Lille Snenæs" a sterile *Zygnema.*

Chlorophyceæ.

Pleurococcaceæ.

Pleurococcus Menegh.

1. **P. vulgaris** Menegh., Näg. Gatt. einz. Alg. p. 64, tab. IV E, fig. 2.

Børgesen, Ferskvandsalg. Østgrønland, p. 36 (Danmarks Ø, Røde Ø, Hekla Havn).

Very few cells were found on bones.

Loc. Stormbugt.

Oocystaceæ.

Oocystis Nägl.

O. spec.?

A few colonies were found of an *Oocystis*-like plant. The cells were roundish-oblong and occurred two together in the mother-cell.

Long. cell. = 32 μ; lat. = 24 μ.

Found in a collection from a small lake.

Loc. Hvalrosodde.

Hydrodictyaceæ.

Pediastrum Meyen.

P. spec.

A quite yonng colony was once found in a collection from Vester Elv.

Loc. Danmarks Havn.

Coelastraceæ.

Coelastrum Näg.

1. **C. microporum** Näg. in A. Braun, Alg. unic. p. 70.

Found in two collections from Vester Elv.

Loc. Danmarks Havn.

Ulothricaceæ.

Stichococcus Näg.

1. **S. bacillaris** Näg., Gatt. einz. Alg. p. 76, tab. IV G, fig. 1.

f. **confervoidea** Hazen., The Ulothricaceæ and Chaetophoraceæ of the U. S. p. 160, tab. 22, fig. 2, 3.

Was found in form of longer or shorter filaments between *Zygnema*.

Breadth of the cell 2,7 μ, the length 2—4 times as great.

Found in a collection from Vester Elv.

Loc. Danmarks Havn.

Microspora Thur.

1. **M. stagnorum** (Kütz.) Lagerh., Entwickelungsg. einiger Confervaceen (Ber. d. d. bot. Ges. 1887, p. 417). Hazen., Ulothricaceæ, p. 176, tab. 24, fig. 12, 13.

Larsen, Freshw. Alg. East Greenl. p. 108 (Falkefjeld, Jameson Land, Sabine Ø).

Lat. cell. = 8,5 μ.

Loc. Lille Snenæs (422).

Tribonema Derb. et Sol.

1. **T. bombycinum** (Ag.) Derb. et Sol., Mém. phys. Alg. p. 18, tab. IV; fig. 16—21. Hazen, Ulothricaceæ, p. 184, tab. 25, fig. 1—3.

Larsen, Freshw. Alg. East Greenl. p. 108 (Found in several localities from Kap Dan (65° 31′) to Sabine Ø (74° 30′).

Lat. cell. = 6—8 μ.

Loc. Lille Snenæs.

Prasiolaceæ.

Prasiola Ag.

1. **P. velutina** (Lyngb.) Wille, Færøernes Ferskvandsalger (Bot. Notiser, 1897, p. 32, tab. 1).

Only a few filaments were found, but these agreed quite well with the original specimen of LYNGBYE. Only filaments with a single row of cells were present.

Lat. of the filament = 14—18 μ.

Loc. Lille Snenæs.

Oedogoniaceæ.

Oedogonium Link.

O. sp. Sterile.

Lat. fil. = 5,5 μ.

Loc. Found in a small lake at Hvalrosodde.

O. sp. Sterile.

Lat. fil. = 11 μ.

Loc. Found in the same locality as the above-mentioned.

Bulbochaete Ag.

B. sp. Sterile.

A form with short cells.

Lat. cell. = 24 μ; long. cell. = 27 μ.

Loc. Found in a collection from a small lake at Hvalrosodde.

B. sp. Sterile.

A form with longer cells (*Bulbochæte setigera*?).

Lat. cell. = 24 μ.

Loc. Found in the same collection as the above-mentioned.

IV.

ON THE MARINE ALGÆ FROM NORTH-EAST GREENLAND

(N. OF 76° N. LAT.)

COLLECTED BY THE "DANMARK-EXPEDITION"

BY

L. KOLDERUP ROSENVINGE

1910

INTRODUCTION.

The Marine Algæ procured during the Danmark Expedition have been collected by the botanist of the Expedition, Mr. Andr. Lundager. As will be seen from the list of stations, they were procured by dredgings partly at the wintering place of the Expedition, partly at various distances from it, outwards and southwards to the small Island Maroussia, inwards and northwards to Stormbugt. Only some few samples of algæ found frozen in the ice or lying on or floating among the ice originate from more distant localities; these however are of less interest, as it is uncertain whether they have grown in the neighbourhood of the place where they were found or far from it. Almost all the gatherings have been made in August and September 1907 and in July 1908. Only the accidental samples mentioned have been collected at other seasons. The collected algæ are partly dried partly preserved in alcohol; some of the larger Laminariaceæ were dried in the air and afterwards salted.

A list of the localities where the algæ were collected is given here. They are disposed from South to North. With exception of the first and the two last, they are all situated between ca. 76° 30′ and ca. 76° 47′ Lat. N. From notes kindly given me by Mr. Lundager I have added some communications about the vegetation and the natural conditions at some of the places.

List of collecting places.

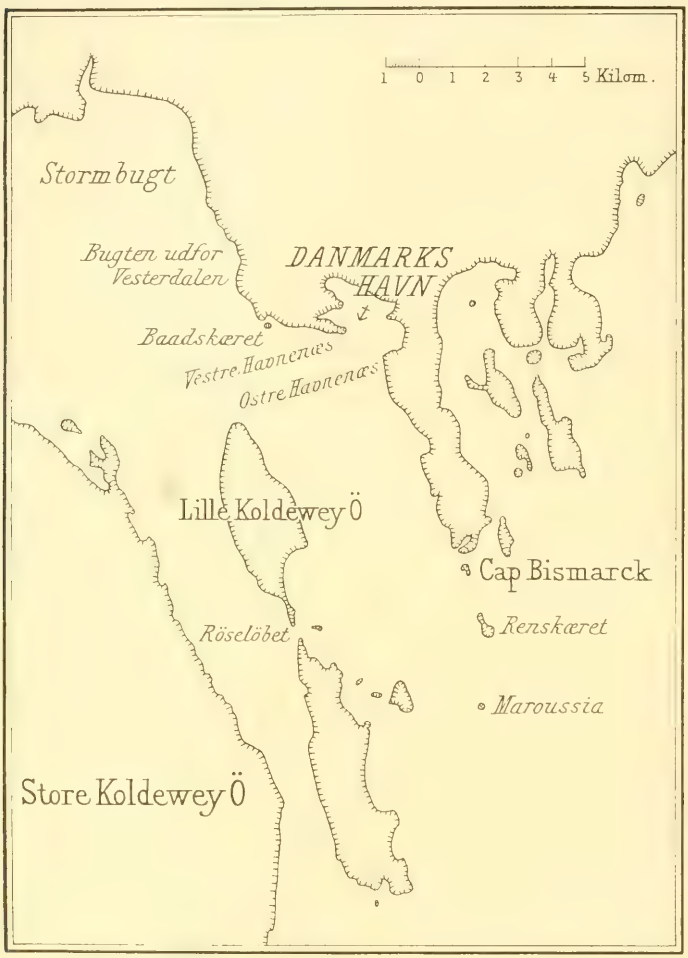
Ca. 75° 50′ Lat. N., 11° 23′ Long. W., Aug. 4th 1906. Floating in the ice.

Along the East side of Store Koldewey Island, and in the bay between the two islands, Aug. 26th. (Calcareous algæ).

— Sept. 5th 1907. In the bay near the low tongue between the islands *Fucus inflatus* was found growing in shallow water. At a depth of 6 to 9 meters were found *Alaria* and *Laminaria* (*saccharina v. grandis*), in 15 meters depth Florideæ. In 19 to 22 meters depth was found *Delesseria* (*sinuosa*) on soft bottom without stones or shells.

At Cape Bismarck, Sept. 28th 1906.

Along Cape Bismarck Peninsula, around Renskæret, and to Maroussia. July 20th 1908. The two *Laminariæ* and *Alaria* were seen growing more or less gregariously in comparatively shallow water between Cape Bismarck and Renskæret. *Delesseria sinuosa*, *Turnerella Pennyi*, *Polysiphonia arctica* a. o. occurred at a some-



Danmarks Havn and surroundings. By Captain J. P. Koch.

what greater depth, probably ca. 20 meters. At a depth of more than 24 meters *Lithothamnia* were dredged, but they were lost by an accident.

Østre Havnenæs. Aug. 15th 1907.

Danmarks Havn. Aug. 1906 (*Laminariæ*).

— Aug. 15th and 28th, Sept. 10th 1907. *Fucus* (*inflatus*) grows in shallow, disturbed water on stony ground around Vestre Havne-

næs at a depth of 2 to 4 meters. — 8 to 11 meters, soft bottom with Florideæ.

Entrance to the harbour (Danmarks Havn), Sept. 9—10th. Calcareous algæ (*Lithothamnia* and other incrusting algæ).

At Vestre Havnenæs, Sept. 4th and 10th 1907. On both sides of the reef projecting from the point of land, 28 meters. In 8 to 11 meters depth *Alaria* with large sporophylls; no calcareous algæ.

— One sample from Vestre Havnenæs, Sept. 4th 1907 must have been collected in the littoral (tidal) region. (Nothing has been noted about the place where it grew.) It contains decidedly littoral alga, such as *Calothrix scopulorum, Enteromorpha prolifera, Pseudendoclonium submarinum, Ectocarpus maritimus* (*Pilinia maritima* (Kjellm.) Rosenv.) further *Rhodochorton* and others.

Along Vestre Havnenæs and off Baadskæret, Aug. 26th 1907. 38 meters and deeper, stony bottom with calcareous algæ and shells of bivalves and barnacles. — In lesser depth associations of *Delesseria* (*sinuosa*) or *Phyllophora* (*Brodiæi* **interrupta*).

— Aug. 28th 1907, 19 to 47 meters, Florideæ.

Stormbugt. *Laminariæ* and *Alaria.*

Bay off Vesterdalen, Aug. 28th 1907, 4 to 11 meters.

Cap Amélie, 77°32′ Lat. N., April 22th 1907, clumps of algæ frozen in the ice.

Hyde Fjord, 83° 15′ Lat. N., May 15th 1907. 4 stipes of a *Laminaria* (probably *L. saccharina* v. *grandis*), found lying on the ice in a dried state by Capt. Koch.

As will be seen from the above list, a well developed sublittoral vegetation seems to exist at several places in the explored area. Thus, *Fucus inflatus* forms a vegetation at a few meters depth under low-water mark. The Laminariaceæ (*Laminaria saccharina* v. *grandis, L. solidungula* and *Alaria Pylaii* v. *grandifolia*) also form true associations at a somewhat greater depth, while the Florideæ are predominant at other places, mostly in greater depths, in particular *Delesseria sinuosa, Turnerella Pennyi, Polysiphonia arctica* and *Phyllophora Brodiæi* * *interrupta.* The brown algæ, except the Laminariaceæ, seem to be less copious; one of the most abundant in the collection is *Desmarestia viridis.* The incrusting algæ seem to occur rather often abundantly at places where other algæ do not occur, in particular on stony bottom in great depths; the most common of these algæ is *Lithothamnion lævе;* further may be named *Lithoderma fatiscens, Lithothamnion glaciale* and *fœcundum, Cruoria arctica* and *Rhododermis elegans.*

Further, it results from the facts related in the list and from

the examination of the collection that associations of loose-lying algæ occur at several places on soft bottom. In this condition *Turnerella Pennyi* occurs in particular very abundantly and further *Phyllophora Brodiæi* **interrupta*, *Polysiphonia arctica*, *Delesseria sinuosa*, *Stictyosiphon tortilis*, *Ectocarpus littoralis*, *Chætomorpha Melagonium*. On the other hand, *Fucus inflatus*, which was so abundant among the loose algæ in Scoresby Sound (Comp. K. Rosenvinge 1898, I p. 47, II p. 219) seems to occur more rarely as loose-lying on the bottom in the explored area. Most of the species named continue probably vegetating for a long time in a loose condition. As formerly stated by me (1898 II p. 221), that *Polysiphonia arctica* is almost always sterile is certainly in connection with the fact that it is not attached to the bottom.

As to the littoral region, it will be seen from the list that one sample only has been collected above low-water mark; but Mr. Lundager has noted that *Fucus inflatus* occurs in clefts in the rocks in the lower part of the littoral region at Vestre Havnenæs and at Cape Bismarck.

Our knowledge of the Marine algæ of East Greenland is due for a great part to collections made during two Danish expeditions in the last decade of the nineteenth century, namely by N. Hartz in 1891—92 (K. Rosenvinge 1898, I) and by C. Kruuse in 1898—99 (H. Jónsson 1904). According to Jónsson 114 species were known from East Greenland in 1904. One of these species, however, *Lithothamnion varians* Foslie, must be omitted, as according to Foslie it must be regarded as a form of *Lithothamnion glaciale* Kjellm. The total number of species therefore becomes 113. The best investigated part of the coast is that situated between 65° 31′ and 70° 27′ Lat. N., while only very few species are known from more northern localities.

In the systematic part of this paper 60 species are recorded (besides two undetermined). 5 of these species are new to Greenland, 3 of them new to science (*Cruoriopsis hyperborea* sp. n., *Punctaria glacialis* sp. n., *Myrionema foecundum* (Strömf.) Sauv., *Arthrochæte phœophila* sp. n., *Pseudendoclonium submarinum* Wille). 11 are new to East Greenland (besides the last-named, further *Lithothamnion tophiforme*, *Chorda tomentosa*, *Phœostroma pustulosum*, *Ectocarpus maritimus* (= *Pilinia maritima* (Kjellm.) Rosenv.), *Epicladia Flustræ*, *Ulothrix scutata*). The total number of species known from East Greenland is thus 124 (besides an undescribed species of *Choreocolax* (?) and perhaps a species of *Acrosiphonia*)[1].

[1] The total number of species known from Greenland was in 1904, according to Jónsson, 176, of which 165 were recorded from the west coast. As *Lithotham-*

Of the 60 enumerated species not less than 9 (15 p. ct.) have only been found on the East coast (besides the five species new to Greenland, further *Chantransia efflorescens, Petrocelis polygyna, Laminaria saccharina* var. *grandis* and *Arthrochœte penetrans*). This rather high number seems to suggest a considerable difference between this area and that of the West coast. Some of these species are however very small and will probably be found also on the West coast on further investigation, like e. gr. *Pseudendoclonium submarinum,* but others are so large and conspicuous that they can scarcely be supposed to have been overlooked, as *Punctaria glacialis* and *Laminaria saccharina* var. *grandis.* It must however be remembered that only the southern part of the West coast can be said to be rather well investigated with regard to the marine algæ, while the part North of 73° Lat. N., with which a comparison would be particularly desirable, is very imperfectly known in that respect.

A comparison of the flora communicated below with a list of the species found in Scoresby sound, ca. 70° 27′ Lat. N. (comp. K. Rosenvinge 1898 I) shows nearly the same number of species. As the last-named locality, in particular Hekla Havn and surroundings, must be considered as comparatively well investigated through N. Hartz's careful collections, we may be permitted to conclude that the material brought home by Mr. Lundager also gives a rather exhaustive idea of the algal flora of that small part of the Arctic Sea where it was gathered. The comparison of the two floræ shows further that a great number of species are common, as was to be expected. Some of the not-common species are so inconspicuous that their absence from one of the areas ought not to be taken into consideration; in other cases their absence cannot be regarded as accidental. As species occurring in Scoresby Sound but wanting in the area here in question might be named: *Dilsea integra* (also found at Sabine Island, 74° 32′ Lat. N.), *Pessonellia Rosenvingii, Scaphospora arctica* (= *Haplospora globosa*?) *Chordaria flagelliformis, Dictyosiphon foeniculaceus, Punctaria plantaginea, Chætomorpha tortuosa.* Further may be named *Agarum Turneri,* the presence of which in Scoresby Sound, however, has not been proved with certainty, and *Ptilota pectinata,* which has been found at Cape Wynn (74° 32′ Nat. N.), though not in Scoresby Sound. Of the species only found North of 76° Lat. N. must especially be named the new species *Punctaria*

nion varians must be omitted (see above), the number must be diminished with 1, but as *Chantransia microscopica* var. *collopoda* must be regarded as a distinct species (comp. K. Rosenvinge 1909 p. 81) the number remains the same. Thus, after the new additions to the flora, the total number for Greenland is 181, for West Greenland 165.

glacialis, which seems to be a strongly arctic species with an extremely northern extension, at least on this coast. The occurrence of *Chorda tomentosa*, though only in feebly developed specimens, appears rather surprising, as it has not hitherto been observed on the East coast. *Lithothamnion tophiforme* may also be named, though it was only represented by one specimen. Thus, a certain floristic difference seems to exist between Scoresby Sound and the area North of 76° Lat. N., depending principally on the absence in the latter of a number of species with a comparatively southern extension but also on the presence of at least one species with hyperborean occurrence.

When considering the number of species within the main groups of algæ the following numbers are found for the area here in question, when the two undetermined species are included:

	Number of species	p. ct.
Rhodophyceæ	23	37·1
Phæophyceæ	23	37·1
Chlorophyceæ	15	24·2
Cyanophyceæ	1	1·6

It is rather surprising that the red and the brown algæ are found to be equally numerous in this area, as it has proved elsewhere that the Phæophyceæ are the most numerous group of algæ in the arctic regions. When comparing these numbers with those found by me for the whole of Greenland (1898, II p. 173[1]), we find that the percentage of the Rhodophyceæ has greatly increased, that of the other groups more or less diminished. On the other hand, we find the same proportion between the red and brown algæ in Scoresby Sound, for in Hekla Havn were found 21 red, 22 brown and 9 green algæ (l. c. p. 232), and including the species found in the neigbourhood of Hekla Havn (l. c. p. 231) we find the following numbers: 26 red, 26 brown and 10 green algæ. The relative number of the Phæophyceæ seems thus to be increasing and becomes predominant on going from the Atlantic northwards to the Arctic Sea, but it diminishes on going further northwards in the strongly arctic parts of the sea, dividing the dominion with the Florideæ which greatly increase in number.

When the 60 species of North-East Greenland are divided into three groups, arctic, subarctic and North Atlantic in a similar man-

[1] I take here the numbers as I found them in 1898 without considering the later additions and corrections to the flora.

ner as that used in 1898 (II), a much smaller number of North Atlantic species results than in the flora of the whole of Greenland, as might be expected. When all the species are included the following numbers result: arctic 35 p. ct., subarctic 46·6 p. ct. and North Atlantic 18·3 p. ct., while the numbers for the whole of Greenland are: arctic 30 p. ct., subarctic 37·7 p. ct. and North Atlantic 32·3 p. ct.[1] When the Rhodophyceæ and Phæophyceæ are only taken in consideration, we obtain for North-East Greenland: **35·6** p. ct. arctic, **53·3** p. ct. subarctic and **11·1** p. ct. North Atlantic species, for the whole of Greenland: 33 p. ct. arctic, 46·1 p. ct. subarctic and 20·9 p. ct. North Atlantic. The last named numbers for North-East Greenland are almost identical with the corresponding numbers for the whole of East Greenland found in 1898 (i. e. for the East coast south of 74° 30′ Lat. N. or more correctly south of 70° 30′ Lat. N.): **36·5** p. ct. arctic, **54** p. ct. subarctic and **11** p. ct. North Atlantic species, (K. Rosenvinge 1898 II p. 180). This striking agreement in spite of the existing floristic differences between the different parts of the East coast seems to be the expression of the pronounced arctic character of the whole coast. Even if the numbers given might be somewhat altered by taking Jónsson's paper (1904) into consideration, and will probably be altered by further investigations, I do not doubt that the agreement mentioned really exists.

LIST OF THE SPECIES.

A. Rhodophyceæ.

Fam. *Corallinaceæ.*

Lithothamnion Phil.

1. **L. tophiforme** Unger.

Foslie (1895) p. 119, (1905) p. 51, K. Rosenvinge (1898 I) p. 13.

The collection contains one specimen only which can be referred to this species. It agrees with the specimens formerly found in West Greenland and has bipartite sporangia (144 μ long, 45 μ thick).

Locality. Entrance to the harbour.

2. **L. glaciale** Kjellm.

Kjellman (1883) p. 123; K. Rosenvinge (1893) p. 773, (1898 I) p. 9.

f. **typica** Foslie (1905) p. 26.

[1] See note page 98.

f. **botrytoides** Foslie (1905) p. 26.

L. *botrytoides* Fosl. in K. Rosenvinge (1898 I) p. 10.
L. *delapsum* f. *conglutinata* Fosl. (1895) p. 50 pl. 14 fig. 4.

f. **subsimplex** Foslie (1905) p. 27.

L. *varians* Fosl. in K. Rosenvinge (1898 I) p. 11.

There are some few specimens belonging to f. *typica*, some others agreeing with f. *subsimplex* and a single specimen belonging to f. *botrytoides*. The specimens referred to f. *subsimplex* are mostly large flat crusts with low rounded processes, with very few and feebly developed or even without such processes. In the latter case I should perhaps not have dared to refer the plant to this species, had not Foslie referred to L. *glaciale* a similar crust from East Greenland which he had formerly referred to L. *varians*. The great variability of the processes and the gradual transition from forms with well-developed branches to those with even crusts make me have no doubt as to the correctness of this determination. The species has been dredged at a depth between 19 and 47 meters and in another place at a depth of 38 meters or deeper.

Loc. Entrance to the harbour; along Vestre Havnenæs; off Baadskæret.

3. **L. foecundum** Kjellm.

Kjellman (1883) p. 131; K. Rosenvinge (1898 I) p. 12, Foslie (1905) p. 21.

The collection contains a number of specimens which in my opinion must be referred to this species. They agree in habit and as to the size and form of conceptacles of sporangia with the descriptions and the formerly collected Greenlandic specimens of this species. The conceptacles, however, were most often empty, and in a single case, when they still contained sporangia, these were two-parted, while the species, according to Kjellman and Foslie, has ordinarily four-parted sporangia. Foslie has also sometimes found the sporangia two-parted, but he supposes that they were not fully developed. The sporangia observed by me were at all events well developed as to the size, for they measured 175—200 μ in length and 77—120 μ in breath. The conceptacles of sporangia were 400—500 μ in diameter. A crust with antheridial conceptacles, ca. 400 μ in diameter, was also met with. — The plants were found growing partly and principally on barnacle-shells, partly on stones, most often in company with *Lithothamnion læve*. — Collected at a depth of 38 meters.

Loc. Along Koldewey Island; entrance to the harbour; along Vestre Havnenæs; off the Baadskær.

4. **L. læve** (Strömf.) Foslie.

Foslie (1898) p. 7; K. Rosenvinge (1898 I) p. 14; Jónsson (1904) p. 6; Foslie (1905) p. 16.

Lithophyllum læve Strömfelt (1886) p. 21 pl. I fig. 11—12.
Lithothamnion tenue K. Rosenvinge (1893) p. 778 ex parte.

This species has been collected in considerable quantities in various localities; it is the species of *Lithothamnion* most represented in the collection. It forms extended thin crusts over stones, and further over shells of bivalves and of barnacles. Usually it has conceptacles of sporangia the diameter of which most frequently attains or even exceeds 1 mm. The sporangia contained in all examined cases two spores only; they were 240—360 μ long, 93—167 μ broad. According to Foslie, (1905), p. 18 and 53, the sporangia are four-parted; he says however that he has "often seen two-parted ones, sometimes even only two-parted ones, particularly in the northern part of the arctic zone. But having found in other specimens, partly from the same places, both two-parted and four-parted ones,

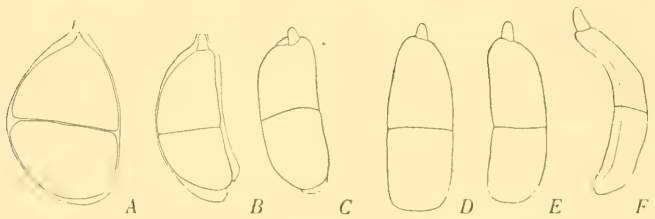


Fig. 1. *Lithothamnion læve,* sporangia. *A—C* from the same conceptacle, *D—F* from another conceptacle. 95 : 1.

sometimes even in one and the same conceptacle, I think it fair to presume that the two-parted ones have not been fully, or normally developed". The fact that I have found only two-parted sporangia in all, not few, examined cases, seems however to favour the belief that this species has only two-parted sporangia in this arctic region. The only argument which could be alleged against this is, that all the specimens in question are collected in August and September and that the sporangia possibly at a later period might be four-parted. After what is known about the fructification of these Algæ, that supposition is however little probable. As shown in fig. 1, the breadth of the sporangia is rather variable, partly according to their place in the conceptacle.

Specimens with sexual conceptacles were also found, though in lesser quantity. These conceptacles are easily recognizable from their conical form and smaller diameter; the conceptacles of cystocarps were 500—800 μ broad, those of antheridia 500—600 μ.

Loc. Along Cape Bismarck Peninsula; in and off the entrance to the harbour; at Vestre Havnenæs, 28 meters; off Baadskæret, 19—47 meters.

Fam. *Squamariaceæ.*

Cruoria Fries.

5. **Cruoria arctica** Schmitz.

K. Rosenvinge (1893) p. 784, (1898 I) p. 15.

It forms crusts up to 4 cm. in diameter on barnacle-shells and on *Lithothamnion lævе;* it seems to be always attached to a calcareous substratum. The specimens of the collection fully agree with the original ones from West Greenland and are, like those, provided with glandular cells. In a thick crust ripe sporangia (56 μ long, 23 μ broad) were found in the upper part while abortive sporangia were visible at a lower level. This species is always infested by *Chlorochytrium Schmitzii.* — Found in various depths e. g. ca. 38 meters.

Loc. Along Koldewey Island; off Baadskæret and along Vestre Havnenæs.

Cruoria firma Kjellman (1906) p. 14, is hardly specifically distinct from *C. arctica.* According to Kjellman it differs from this species by having the basal layer consisting of at least two layers. This statement, which is put forward however by the Swedish author with some reservation, I suppose to be founded on imperfect preparation; sections of *C. arctica* which are not very thin or exactly vertical lead easily to the belief that there is more than one basal layer of cells. The sporangia appear to offer no difference; they were only comparatively narrow in Kjellman's specimens. And the erect filaments seem to have essentially the same structure as in *Cr. arctica.*

Petrocelis J. Ag.

6. **P. polygyna** (Kjellm.) Schmitz.

K. Rosenvinge (1898 I) p. 16.

Hæmescharia polygyna Kjellman (1883) p. 182.

Some few crusts of this species, partly sterile, partly with carpogonia have been found growing on stones.

Loc. Along Vestre Havnenæs, ca. 38 meters, and another locality.

Cruoriopsis Dufour.

7. **C. hyperborea** sp. n.

Crusta intense sangvinea, 80—100 μ crassa. Stratum basale unistratosum, e filis radiantibus compositum, cellulis 4·5—5·5 μ crassis, 8—10·5 μ altis, crassitudine vulgo 2—3-plo longioribus. Fila erecta 5—8-cellularia, cylindrica vel sursum paulo incrassata, 7·5—10 μ crassa, cellulis diametro aequilongis vel ad duplo longioribus, chromatophorum unicum continentibus. Sporangia in filis erectis terminalia vel in parte superiori eorum lateralia, sessilia vel rarius stipitata, obovata vel breviter oblonga, 15—23 μ longa, 11—13 μ lata.

One crust only of this new species has been found growing on a stone. It has a deep blood-red colour, by which it differs from

the other crustiform Florideæ of the collection. The cells of the basal layer are about twice as high as they are broad. Fusions sometimes occur between cells belonging to neighbouring cell-rows of the basal layer. The erect filaments are not connected by any soft gelatinous matter; they are of the same thickness in their whole length or upwards somewhat thicker; their cells are usually $1^1/_2$ to 2 times as long as broad, more rarely of the same length. The cells contain a single chromatophore lying in the upper part of the cell, apparently cup-shaped. The filaments are sometimes a little branched at the upper end, bearing one or two (or perhaps

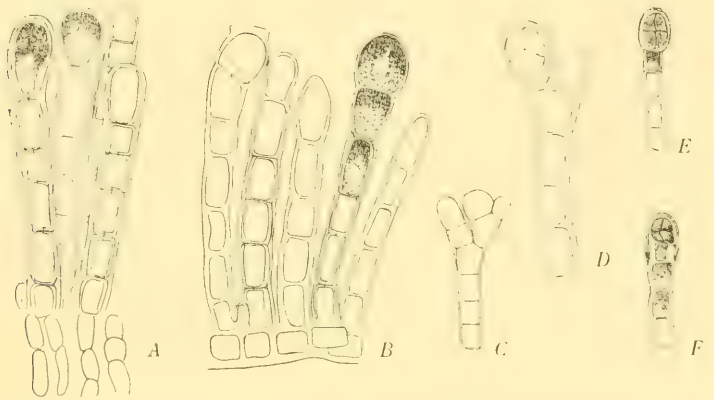


Fig. 2. *Cruoriopsis hyperborea*. *A*, portion of the basal layer seen from above and vertical filaments springing off from it, two of them ending in a sporangium. *B*, vertical section of a crust, the filaments somewhat disunited. *C*, vertical filament branched at the upper end. *D*, vertical filament bearing a lateral sporangium. *E* and *F*, vertical filaments with terminal sporangia. *A*, *B*, *D* 555 : 1; *C*, *E*, *F* 345 : 1.

more than two) short one- or two-celled branchlets. Possibly ramification only takes place by the formation of sporangia.

The sporangia are placed on the ordinary filaments and are usually terminal but never emerging over the surface of the frond. They may also be lateral on one of the upper joints of a filament and are then usually sessile (fig. 2 *D*); sometimes however two-celled branchlets occur, the upper cell of which will develop into a sporangium (fig. 2 *C*). The sporangia are obovate, more rarely shortly oblong; their division is always cruciate, the first dividing wall being horizontal. Sometimes the first division wall is oblique and the arrangement of the spores somewhat irregular.

Our plant having no sex-organs, its systematic position cannot be determined with certainty. I think however it could be referred

to the genus *Cruoriopsis,* as a new species. At all events it cannot belong to the genus *Cruoriella,* the sporangia not occurring in nemathecia but scattered in the very crust. It reminds one somewhat of *Cruoriella armorica* Hauck (1885, p. 31, non Crouan) which is referred to the genus *Cruoriopsis* by Batters (1896, p. 387) under the name of *C. Hauckii.* De-Toni (1905, p. 1690), has certainly protested against its translation to this genus, as it has terminal sporangia; this however does not appear convincing to me, the diagnosis of the genus *Cruoriopsis* containing nothing very precise as to the position of the sporangia (comp. De-Toni l. c. and Schmitz und Hauptfleisch (1897, p. 535)). In *Cruoriopsis cruciata* Dufour the sporangia are certainly lateral on the filaments (comp. Zanardini (1876), Tav. 86), but in our species lateral sporangia also occur though more rarely than the terminal ones. I think it therefore most correct, at least provisionally, to refer it to the same genus.

I have been able to compare our plant with a microscopical preparation of *Cruoriopsis Hauckii* Batt. from Plymouth, kindly sent me by the late Mr. Batters, thus an original specimen. It differs by having thinner erect filaments, ca. 4 μ thick or a little thicker, consisting of more elongated and more thin-walled cells. The sporangia are more lengthened, narrower, 21—25 μ long, 7—8 μ broad, always terminal on the ordinary erect filaments, scattered in the crust; the divisions are cruciate but oblique. In the basal layer numerous transversal fusions occur.

Through the kindness of Mrs. Weber—van Bosse I have also been able to examine two microscopical preparations of *Cruoriella armorica* Hauck, from the collection of Hauck, originating from Naples. This plant is also different from the Greenland one. The basal layer consists of broad cells arranged in regular radiating filaments, the erect filaments are thinner, sometimes dichotomous above. The sporangia are always terminal, they are larger, 46—56 μ long, 26—28 μ broad, regularly cruciate.

Loc. Along the Koldewey Island, Aug. 26th 1907 (No 556).

Rhododermis Crouan.

8. R. elegans Crouan.

K. Rosenvinge (1898 I) p. 18.

Crusts of this species, recognizable by their dull rose-red or light purple colour have been found growing on stones from various localities. They are always polystromatical and may be up to 20 cells thick and even thicker. The vertical filaments are 7—9 μ thick; the height of the cells is variable, sometimes about the same

as the breadth or a little greater, in other cases smaller; in the upper part of some crusts the cells were very low, several times broader than high. Transversal fusions between the cells, especially those of the basal layer, but also those of the vertical filaments (fig. 3 *A*) occur here and there.

Some crusts bear sori of sporangia, with unripe or fully developed sporangia; in other cases the sori had fully developed paraphyses but no sporangia, these having probably decayed. Ripe sporangia, found in August, were 30—32 μ long, 19—20 μ broad.

Some other crusts, collected in August and September, bear antheridia, which organs were hitherto unknown in this genus. They covered a great part of the surface of the frond as a continuous layer of much greater extent than the sporangial sori. The antheridia (spermatangia) are obovate, 10—11 μ long, 4 μ broad. In a vertical section the vertical cell-rows are seen bearing at their upper end one or usually two cells, which are smaller and richer in plasmatic contents than the vegetative cells and bear the antheridia. These cells (Svedelius's spermatangial mother-cells) bear at the top two antheridia, a terminal and a lateral one, or perhaps more. By the development of the antheridia the thick cuticula is lifted and finally thrown off by the developing antheridia. The spermatia are, like the antheridia, obovate and contain a very distinct nucleus, lying in the upper part or the middle of the cell.

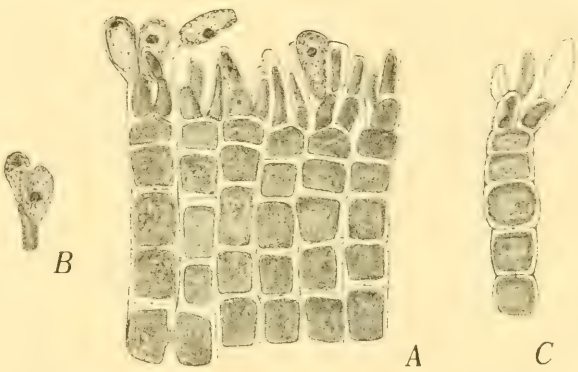


Fig. 3. *Rhododermis elegans*, sections of male plant. *A*, Vertical section of crust with antheridia. *B*, antheridia-bearing cell with two antheridia. *C*, Vertical cell-row with two antheridia-bearing cells. 830 : 1.

Carpogonia were not observed.

Loc. Along Koldewey Island; entrance to the harbour (♂ and spor.); off Baadskæret and along W. Havnenæs, ca. 38 meters (♂ and spor.)

Fam. *Ceramiaceæ*.

Antithamnion Næg.

9. **A. Plumula** (Ellis) Thur. *β*, **boreale** Gobi

K. Rosenvinge (1898 I) p. 21, Jónsson (1904) p. 8.

This species has been found growing on *Phyllophora Brodiæi* f. *interrupta, Delesseria sinuosa* and *Lithothamnion glaciale.* The specimens were 1 to 2 cm. long, all sterile.

Loc. Danmarks Havn and the entrance to it.

Rhodochorton Næg.

10. **R. Rothii** (Turt.) Næg.

K. Rosenvinge (1893) p. 791, (1898 I) p. 23, Jónsson (1904) p. 8.

This species has been found in two different sublittoral localities in up to ca. 40 meters depths; it was here mostly found in company with *Cruoria arctica,* forming scattered tufts on the surface of the latter. A closer examination showed however that, at all events in some cases, it had grown through the crust of *Cruoria,* the basal layer being situated under the crust. This has probably been occasioned by the *Cruoria* overwhelming the *Rhodochorton* growing previously on the stone. This supposition is supported by the fact that the same *Rhodochorton* was found growing on *Lithothamnion læve* covering the stone beside the *Cruoria.* These specimens were all sterile.

Fertile specimens with ripe and empty sporangia were found in September in company with *Calothrix scopulorum* a. o. in a gathering from the littoral region.

Loc. Along Koldewey Island; Vestre Havnenæs, in the tidal region; off Baadskæret and along Vestre Havnenæs, ca. 40 meters.

11. **R. penicilliforme** (Kjellm.) K. Rosenv.

K. Rosenvinge (1894) p. 66, (1898 I) p. 23, Jónsson (1904) p. 9.

R. *mesocarpum* (Carm.) Kjellm. var. *penicilliforme* Kjellm., K. Rosenvinge (1893) p. 792.

One specimen of this easily recognizable species was found on *Polysiphonia arctica;* the upright filaments were 10 μ thick and bore young sporangial branchlets but without sporangia.

Loc. Along Koldewey Island, ca. 8 fathoms.

Fam. *Rhodomelaceæ.*

Rhodomela C. Ag.

12. **R. lycopodioides** (L.) Ag. f. **tenuissima** (Rupr.) Kjellm.

K. Rosenvinge (1893) p. 797, (1898 I) p. 24, Jónsson (1904), p. 9.

This species is only feebly represented in the collection. At Koldewey Island, where it was collected by dredging in September, it occurred in small quantity among *Stictyosiphon tortilis;* the specimens had still hairs (trichoblasts), branched and unbranched, but

were sterile. Specimens found frozen in the ice in April bore tetrasporangia in the shoots of the previous year.

Loc. Along Koldewey Island; in clumps frozen in the ice at Cap Amélie.

Polysiphonia Grev.

13. **P. arctica** J. Ag.

K. Rosenvinge (1893) p. 800, (1898 I) p. 25; Jónsson (1904), p. 10.

Non *Pterosiphonia arctica* Setchell and Gardner (1903) p. 329.

A considerable number of specimens of this strongly arctic species has been collected in two localities situated comparatively near the open sea; they fully agree with typical specimens, reaching a length of over 20 cm. and are as usual without basal part. They seem not to have been fixed to the bottom and are all sterile.

Pterosiphonia arctica Setchell and Gardner (l. c.) which these authors have thought identical with *Polysiphonia arctica*, after comparison with a specimen from Greenland determined by me, is fairly distinct from it, judging from the remarks and the figures of the authors. The Northwest American species has a complanated frond, is plainly distichous near the tips and has constantly 6 or 7 pericentral cells, while *Polysiphonia arctica* has a cylindrical frond with branches given off on all sides and 4—7 pericentral cells. As no figures of this species have ever been published, I give here some drawings, showing the ramification and transverse sections of the frond (fig. 4). The branches are spirally arranged with an angle of divergence approaching to 180°, however somewhat smaller. As shown before (1893, p. 800) no hairs (trichoblasts)

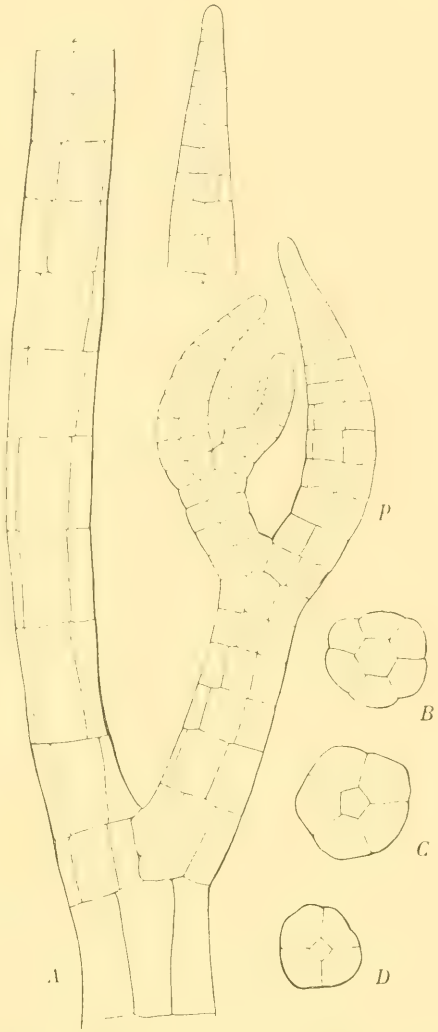


Fig. 4. *Polysiphonia arctica*. *A*, Upper end of a plant; at *p* formation of the secondary pores. *B—D*, transverse sections of fronds. 200 : 1.

occur. The specimen figured had 4—6 pericentral cells; the number was greatest in the main axes.

Loc. Along the East side of Koldewey Island, ca. 15 meters; off Cape Bismarck Peninsula.

Fam. *Delesseriaceæ.*

Delesseria Lamour.

14. **D. sinuosa** (Good. et Woodw.) Lamour.

K. Rosenvinge (1893) p. 808, (1898 I) p. 27; Jónsson (1904) p. 11.

The collection contains a considerable number of well-developed specimens of this species. They attain a length of 25—30 cm. or even more and are also broad, and they belong to the f. *typica.* Some of them bear at the base a considerable number of narrow shoots which had attached themselves on gravel or fragments of shells. One specimen was attached to a barnacle. A number of the specimens seem however to have been loose-lying on the bottom. Specimens collected in July and August showed ripe tetrasporangia, in small marginal leaflets, or cystocarps.

Loc. Along the East side of Koldewey Island, 19—23 meters; along Cape Bismarck Peninsula; off Cape Bismarck; Danmarks Havn; off Baadskæret; the bay off Vesterdalen.

Fam. *Rhodymeniaceæ.*

Halosaccion Kütz.

15. **H. ramentaceum** (L.) J. Ag.

K. Rosenvinge (1893) p. 825, (1898 I) p. 43; Jónsson (1904) p. 12.

Only 3 specimens have been met with in the collection. They have a single set of unbranched branches, are provided with hyaline hairs but are sterile.

Loc. The bay off Vesterdalen, in at most 4 meters depth.

Fam. *Rhodophyllidaceæ.*

Euthora J. Ag.

16. **E. cristata** (L.) J. Ag.

K. Rosenvinge (1893) p. 813, (1898 I) p. 28; Jónsson (1904) p. 13.

A number of specimens, all epiphytic, mostly on *Chætomorpha Melagonium* and *Delesseria sinuosa,* further on *Phyllophora Brodiæi* **interrupta* and *Turnerella Pennyi,* are contained in the collection. They all belong to f. *angustata.* The largest specimens are 5 cm. long. Ripe tetrasporangia and cystocarps occurred in specimens collected in August and September.

Loc. At Koldewey Island; Danmarks Havn.

Turnerella Schmitz.

17. **T. Pennyi** (Harv.) Schmitz emend.

F. Schmitz in K. Rosenvinge (1893) p. 815; K. Rosenvinge (1898 I) p. 29; Jónsson (1904) p. 13.

Inclus. *Kallymenia rosacea* J. Ag. (1876) p. 220, comp. Børgesen and Jónsson (1905) p. XII.

A great number of specimens of this arctic species have been collected at various localities, most abundantly in Danmarks Harbour. The form of the frond is somewhat variable, in some cases of nearly orbicular outline, usually however more or less lobed and often also undulated. Most of the specimens are devoid of basal disc and have probably been so at the moment of dredging. Some of the specimens, however, show well-developed basal discs mostly attached to barnacles. Some of the specimens provided with basal disc seem not to have been attached, when they were collected, as is to be concluded from the form of the basal disc, its under face not being plain but hollow, by strong development of the border, probably after its detachment from the substratum. The reason why almost all the specimens are without basal disc may be in some cases, that the plant has been torn away from its substratum, leaving its basal part; I imagine however that most of the specimens have been really loose-lying on the bottom. This is suggested by the form of the frond and by the fact that most of the numerous specimens from Danmarks Harbour have been dredged at a locality where the bottom is soft.

Some of the specimens agree fully with specimens referred by J. Agardh to *Kallymenia rosacea*, which however is not specifically distinct from *Turnerella Pennyi*, as stated by Børgesen and Jónsson (l. c.) and as suspected already by J. Agardh (l. c.)

The largest of the specimens contained in the collection measures 50 cm. in greatest diameter in a dried state. Some specimens contain numerous cystocarps, partly ripe, partly empty.

Loc. Along the East side of Koldewey Island, ca. 15 meters; off Cape Bismarck; along Cape Bismarck Peninsula; Danmarks Havn, 7—11 meters, soft bottom; off Baadskæret, 28 meters; the bay off Vesterdalen, 4—11 meters.

Fam. *Gigartinaceæ.*

Phyllophora Grev.

18. **Ph. Brodiæi** (Turn.) J. Ag. ***interrupta** (Grev.) K. Rosenv.

K. Rosenvinge (1893) p. 821, (1898 I) p. 32; Jónsson (1904) p. 14.

All the specimens of the collection belong to the subsp. *interrupta;* they are well-developed; partly very broad, and up to 18 cm. high. Nearly all the specimens have no basal portion and have

certainly been lying loose on the bottom; in some of them the undermost part is in a state of disintegration. For most of the specimens from the harbour it has also been stated, that they have been dredged on soft bottom. Some smaller specimens are however provided with basal disc.

Loc. Along Koldewey Island, 15 meters and deeper; Danmarks Havn, 7—11 meters, soft bottom.

Actinococcus Kütz.

19. **A. subcutaneus** (Lyngb.) K. Rosenv.

K. Rosenvinge (1893) p. 822, (1898 I) p. 33; Jónsson (1904) p. 14.

A large specimen of *Phyllophora Brodiæi* **interrupta* bears numerous specimens of this much disputed alga attached to the upper margin of some of the one-year old segments.

Loc. Along Koldewey Island, ca. 15 meters.

Ceratocolax K. Rosenv.

20. **C. Hartzii** K. Rosenv.

K. Rosenvinge (1898 I) p. 34.

Several specimens of *Phyllophora Brodiæi* **interrupta* are infested with this parasite which is situated partly on the border partly on the flat side of the frond. The specimens of the parasite form small bushes up to 3 mm. in diameter, fully agreeing with the previously found Greenlandic specimens; several of them bore nemathecia, but the sporangia were still undivided in August. The specimens of *Phyllophora* on which they were parasitic were certainly all loose-lying when dredged.

Loc. Danmarks Havn, 7—11 meters, August.

Choreocolax sp.?

In a specimen of *Euthora cristata* from Koldewey Island were found some cushions of a small parasitic Floridea looking much like a *Choreocolax* or *Harveyella*. As there is not sufficient material for a detailed description, I shall not mention it closer but only state that it grows in the same manner as *Harveyella* and *Choreocolax*, sending out from the underside of the cushion-shaped or nearly globular frond filaments penetrating between the cells of the host. In a dried state the parasite has a pretty red colour.

Fam. *Helminthocladiaceæ*.

Chantransia (D. C.)

21. **Ch. efflorescens** (J. Ag.) Kjellm.

K. Rosenvinge (1898 I) p. 40, (1909) p. 134.

Found in small quantity on *Delesseria sinuosa* and *Cruoria arctica*. The thickness of the filaments is 5—6 μ. Antheridia, carpogonia and ripe cystocarpia occurred in August.

Loc. Along Koldewey Island; Danmarks Havn and the entrance to the harbour.

Fam. *Bangiaceæ*.

Conchocelis Batt.

22. **C. rosea** Batters.

Batters (1892) p. 25; K. Kosenvinge (1898 I) p. 44.
Non *Ostreobium Queketti* Born. et Flah. var. *rosea* Nadson (1900) p. 36.

This perforating alga is frequently met with in old shells in particular of *Mya* and *Saxicava*, which assume a rose-red colour when the alga occurs alone or is predominant. It agrees very well with Batters' description and figures. According to Nadson (l. c.) this alga should not be a *Rhodophycea* but a red variety of *Ostreobium Queketti*; this however does not agree with my observations of the material from North-East Greenland. *Conchocelis* and *Ostreobium* grow frequently intermingled in these shells, but they are very easy to distinguish and do not show any indication of mutual transition. *Conchocelis* is always rose-coloured, while *Ostreobium* is constantly green. *Conchocelis* consists always of articulated filaments, the cells of which are more or less inflated in the middle but narrow at the transverse walls, while the filaments of *Ostreobium* are continuous and show here and there large irregular inflations. As far as I know, Nadson has given no account of the manner in which the transition takes place between these two widely different algæ[1], and it seems therefore most probable, that the red alga which Nadson examined is not the true *Conchocelis rosea* but rather a red variety of *Ostreobium Queketti*.

As stated by Batters, the alga forms within the surface of the shell a horizontal layer of interlaced filaments of very various shapes and widths. The cells are often inflated in the middle and the filaments may then be more or less moniliform. I have not been able to detect any pore in the middle of the transverse walls. In the deeper parts of the shell some filaments are thicker, consisting of short cylindric cells separated by broader transverse walls and with rich plasmatic contents (comp. Batters l. c. pl. VIII figs. 2—6). In the thinner cells I have found a parietal chromatophore which seems to be much branched; in some cases I saw however several intensely red-coloured bodies in each cell, probably chromatophores. In some

[1] Mag. O. Paulsen has most kindly translated for me the part of Nadson's Russian text treating of *Conchocelis*.

cases I have found in the thicker filaments one intensely red-coloured body in some of the cells, similar to those taken for spores by Batters. I have not submitted this interesting alga to a more detailed study and therefore cannot express an opinion on the question of its systematic position; I refer it with doubt to the *Bangiaceæ*[1].

Loc. East side of Koldewey Island; entrance to the harbour; at Vestre Havnenæs; off Baadskæret.

B. Phæophyceæ.

Fam. *Fucaceæ.*

Fucus (L.) Dcne et Thur.

23. **F. inflatus** L.

K. Rosenvinge (1893) p. 834, (1898 I) p. 45; Jónsson (1904) p. 19.

This species seems to be common in the upper sublittoral region, in particular in the harbour where it grows gregariously at a depth of 2 to 4 meters, on stony ground, but it occurs also in the littoral region (comp. p. 96). It occurs in a form coming near to f. *evanescens*. The frond is up to 12 mm. broad, the midrib well developed, the border sometimes feebly undulato-serrate. The receptacles are short, seldom over 5 mm. long. The largest specimen is 30 cm. long. Inflations filled with air have not been observed. Some plants, which have perhaps been loose, approach to f. *membranacea*. The species for the rest only rarely occurs among other loose algæ. Found with ripe sex-organs in August and September.

Loc. East side of Koldewey Island; Cape Bismarck; Danmarks Havn; Baadskæret.

Fam. *Laminariaceæ.*

Alaria Grev.

24. **A. Pylaii** (Bory) J. Ag. emend. var. **grandifolia** (J. Ag.) Jónsson.

Jónsson (1904) p. 21.

The Alariæ contained in the collection belong undoubtedly all to the same species. They have all a long stipital part, the greater part of which belongs to the rachis. It agrees in this and in its large dimensions with *A. grandifolia* J. Ag. The base of the lamina, however, is often comparatively narrow, cuneate; it may also be rounded ovate, but I have never found it „eximie subcordato-ovata",

[1] In (1909) I have not mentioned this alga under the *Bangiaceæ*, as a provisional examination led me to believe, that Nadson's above-mentioned supposition was right.

as J. Agardh describes it (1872 p. 26). The lamina is thin as in *A. membranacea* J. Ag. (*A. Pylaii β, membranacea* K. Rosenv.). Jónsson

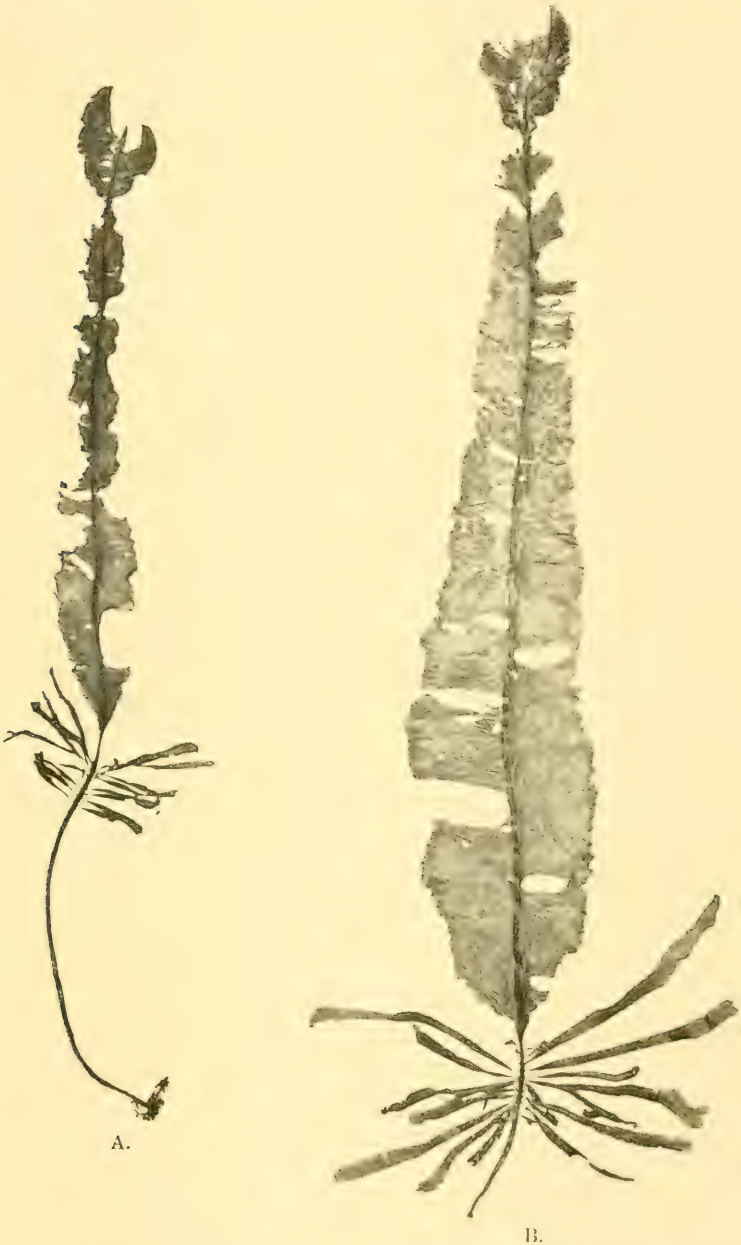


Fig. 5. *Alaria Pylaii* var. *grandifolia*. The lower part of the stipe is wanting in *B*. From dredging along Cape Bismarck Peninsula, July. *A* 1 : 11·5. *B* 1 : 13.

also found, in Kruuse's collection from East Greenland, specimens of *A. grandifolia*, but he thought that this species, at least provisionally, might be regarded as a variety of *A. Pylaii*, and he pointed

out in particular its close relation to the var. *membranacea*. Considering the great variability of *A. Pylaii* which I have been acquainted with on the Western coast of Greenland, I am inclined to believe that this translation is legitimate, but it must be admitted, that it is very difficult to decide, whether the differences existing between the plants from North-East Greenland and those from the southern part of the West coast are due to the differences in the external conditions or are of specific value. When considering the great number of species of *Alaria* described, I cannot help thinking, that the variation of the species has often been taken too little into consideration. The specimens from North-East Greenland are distinguished from those from West Greenland — which I have determined formerly as *A. Pylaii α typica* and *β membranacea* — in my opinion only by their long and well-developed rachis.

The collection contains unfortunately only a few complete and well-developed specimens. In order to give an idea of the dimensions, I give here some measurements in centimeters:

Stipe, included rachis	Length of new lamina	Length of rest of old lamina	Greatest breadth of lamina	Greatest length of sporophylls
$26 + x$	80	17	17	30
64	82	13	13	18
$33 + x$	160	20	33	46
71	151	22	ca. 40	42
$72 + x$	70		32	over 100

The costa was in all cases convex on both sides, the cryptostomata were usually very distinct. As will be seen from the table, the sporophylls attain a very considerable length; their sterile upper part is sometimes bipartite.

According to Kjellman (1877, p. 11) the lamina of *Alaria grandifolia* is shed in winter at Spitzbergen, and that seems to be the case also at the shores of North-east Greenland. The lower part of the old lamina remains however and is to be found still in the following summer. The limit between the laminæ of the two years is marked as a strong narrowing (fig. 5), much as in *A. esculenta*, as shown by R. Rasmussen (1909).

Loc. Along Koldewey Island, ca. 5—15 meters; along Cape Bismarck Peninsula; Stormbugt.

Laminaria Lamx.

25. **L. saccharina** (L.) Lamx. var. **grandis** Kjellm.

Kjellman (1890) p. 25; Jónsson (1904) p. 27.

This species is common in the region explored. A considerable number of specimens have been collected in various localities; only

a few large and well preserved plants have however been brought home. They seem to be referable to f. *grandis* Kjellm. and agree with the specimens from East Greenland determined to this form by Jónsson. The stipe is, in larger plants, now rather short, e. gr. 30 cm., now long (over 106 cm.). The lamina bears always, in July to September, a remnant of the lamina of the foregoing year at the top, sharply marked against the new lamina by means of a strong narrowing. The new lamina is up to 100 cm. long, up to 50 cm. broad, with very undulated border and with broadly cuneate to rounded base. In older plants the lamina may be provided with a network of lists, in the median part as well as the marginal ones. The lamina has always muciparous canals; in some cases they are rather small, in others they are larger and visible with the naked eye from the face, in particular after staining with methylene-blue. The sorus is distinctly limited, elliptical or oblong. In most of the fertile specimens only remains or traces of a sorus are visible in the old lamina, most often only a hole indicating the outline of the sorus, while a sorus is not yet visible on the new lamina, which seems to show that the sorus is not developed before winter. The hole reached in a larger plant to the very base of the old lamina.

The hapteræ are always feeble with long thin branches. Some specimens were attached to stipes of the same species.

Some narrow specimens approach to f. *glacialis* K. Rosenv. (1898 I).

Loc. Along Koldewey Island; along Cape Bismarck Peninsula; Danmarks Havn; Baadskæret; bay off Vesterdalen, 2—11 meters. From Hyde Fjord were brought home by Capt. Koch 4 stipes with hapteræ, probably belonging to this species, found on the ice on May 15th 1907.

26. L. solidungula J. Ag.

J. Agardh (1868) p. 3; K. Rosenvinge (1893) p. 850, (1898 I) p. 57; Jónsson (1904) p. 28.

This strongly arctic species is common within the explored area, where it seems to thrive well. The plants had only one constriction, at the limit between the new lamina and that of the foregoing year, but in most of the plants the latter is not complete, probably because it has been lost during collection or under the preservation. In a few cases only the lamina of the foregoing year was complete and bore further at the top a remnant of the two years old lamina (comp. J. Agardh l. c. plate I fig. 2). The largest specimen brought home has a total length of 133 cm.; thereof the stipe 39 cm. long, the new lamina 69 cm. long, 40 cm. broad, the lamina of the foregoing year (incomplete) 25 cm. long. The broadest specimen is 45 cm. broad. In some cases a well-developed sorus occurred at the base of the one year old lamina. The named greatest

specimen, collected Aug. 15th, has a sorus at the base of the old lamina, and a new sorus is developing in the lower part of the new lamina, but in the other plants collected in July and August a new sorus was yet not visible[1].

The muciparous canals are particularly well-developed in this species; they form a network which is easily visible with the naked eye in dried specimens and in specimens preserved in alcohol; they become particularly conspicuous after staining with methylen-blue[2].

Loc. Renskæret, 2—4 meters; along Cape Bismarck Peninsula; east side of Koldewey Island; Danmarks Havn; Baadskæret.

Fam. *Chordaceæ.*

Chorda (Stackh.)

27. **Ch. tomentosa** Lyngb.

K. Rosenvinge (1893) p. 854.

In a gathering preserved in alcohol two small specimens of a *Chorda* were found, intermingled among other algæ. They were certainly sterile and feebly developed, but the hairs containing numerous chromatophores showed them to belong to *Ch. tomentosa*. They were about 5 cm. long and had not yet begun to develop the outer, fertile layer.

Loc. Bay off Vesterdalen in a depth of at most 4 meters, Aug. 28th.

Fam. *Desmarestiaceæ.*

Desmarestia Lamx.

28. **D. aculeata** (L.) Lamx.

K. Rosenvinge (1893) p. 857, (1898 I) p. 59; Jónsson (1904) p. 32.

Found at several localities, but only abundant at one. One specimen has the basal portion; in this the primary axis bears below two pairs of opposite branches, while the branches otherwise are always alternate. I have found the same in plants collected on the shores of Denmark. Plants collected in the middle of July

[1] Jónsson found many specimens in Kruuse's collections from East Greenland, the lamina of which was divided into four parts (in one plant into five) and he takes it for granted that these sections or laminæ have developed in four (five) consecutive years. The fact that some of these plants bear a sorus or mark after an emptied sorus on the uppermost section only, while the three younger segments do not yet show any trace of a sorus, (l. c. p. 28, fig. 2), suggests the question whether more than one section may not exceptionally be formed in the same year.

[2] While Areschoug (1883 p. 7) did not find muciparous canals in the lamina of this species, Guignard (1892 p. 37) found them in all examined specimens, though in some cases they were small and not easily visible.

were still in growth and had the new branches beset with long brown hairs. One specimen dredged in August was still beset with hairs while hairs were wanting in the other specimens gathered in August and September.

Loc. At the East side of Koldewey Island; along Cape Bismarck Peninsula (abundantly); Danmarks Havn; Baadskæret; bay off Vesterdalen.

29. **D. viridis** (O. F. Müll.) Lamx.

K. Rosenvinge (1893) p. 859, (1898) p. 60; Jónsson (1904) p. 32.

The plants collected are on the whole well-developed and attain a length of over 30 cm. The growth has ceased and the hairs are thrown off in August. — Found in depths from 4 to 11 meters, and perhaps deeper.

Loc. Along Koldewey Island; Danmarks Havn; bay off Vesterdalen.

Fam. *Punctariaceæ.*

Scytosiphon (Ag.)

30. **S. Lomentaria** (Lyngb.) J. Ag.

K. Rosenvinge (1893) p. 863, (1898 I) p. 62; Jónsson (1904) p. 33.

A very badly preserved, ca. 4 cm. long fragment of a tubular brown alga without base and upper part seems to belong to this species. As it has neither sporangia nor paraphyses, the determination is however uncertain. It differs from *Chorda* through lesser consistency and the structure of the frond.

Loc. East side of Koldewey Island, September.

Symphyocarpus K. Rosenv.

31. **S. strangulans** K. Rosenv.

K. Rosenvinge (1893) p. 896, (1898 I) p. 67.

Found in small quantities on older fronds of *Turnerella Pennyi* and on crusts of *Lithothamnion*, in the latter case forming ca. 2 mm. broad crusts. In all cases brown paraphyses were observed; young and empty plurilocular sporangia were also recorded. The plants were collected in September.

Loc. Danmarks Havn; along Vestre Havnenæs and off Baadskæret.

Phæostroma Kuckuck.

32. **Ph. pustulosum** Kuckuck.

Kuckuck (1895) p. 182; K. Rosenvinge (1898 I) p. 68, fig. 15.

This minute species was found on the upper end of a young *Alaria*. The plants agreed with those found on young fronds of *Laminaria nigripes* which I have formerly mentioned (l. c. p. 68 lowest). The plurilocular sporangia reach as a rule to the bottom

of the plant, a sterile basal cell, as in Kuckuck's plants (l. c.), being not developed. Such a cell, however, is always met with under the hairs which have the structure described by me (l. c.). The undermost long cell of the hair is as a rule somewhat constricted at some distance from the base. In some cases I found the cell situated under the hair developed into a sporangium, the cell having protruded on one side and upwards along the base of the hair and formed an opening at the upper end of the prolongation. I am uncertain whether unripe unicellular sporangia also occur.

Loc. Along Cape Bismarck Peninsula.

Stictyosiphon Kütz.

33. **S. tortilis** (Rupr.) Reinke.

K. Rosenvinge (1893) p. 868, (1898 I) p. 70; Jónsson (1904) p. 34.

Occurs rather abundantly in gatherings from the harbour and some other localities, but almost always loose, together with other loose algæ, as *Pylaiella*, and sterile. One filament only, taken in the harbour in August, had well-developed, rather prominent plurilocular sporangia. In the old loose plants the articulation is often very prominent, much as in some *Sphacelaria*. Hairs occur only rarely. Found in 4 to 11 meters depth.

Loc. Danmarks Havn; Baadskæret; bay off Vesterdalen. In clumps in the ice at Cape Amélie, April.

Punctaria Grev.

34. **P. glacialis** n. sp.

Frons eximie stipitata, stipite 5 — c. 14 mm. longo, superne abrupte cuneatim dilatato. Lamina oblonga vel lingulata aut late elliptica, basi late cuneata, long. 17 — c. 45 cm., latit. 4—14·5 cm., plerumque 4—7·5 cm., crassit. ad 140 μ, colore in sicco olivaceo-fusco, substantia tenera, fragili, e stratis cellularibus 3—6 composita, cellulis interioribus quam exterioribus aliquantum majoribus. Pili omnino desunt. Sporangia unilocularia sparsa, ex exteriori visa eadem fere forma ac cellulæ vegetativæ exteriores, parte interne sæpe latiore, alt. 45—53 μ, latitudine supra 21—25 μ, infra 30—50 μ.

This good-sized species most resembles *Punctaria latifolia* Grev. as to the form and the consistency of the frond. It is distinguished from it through the darker colour and the want of plurilocular sporangia. In colour and structure it more resembles *P. plantaginea* (Roth) Grev. The want of hairs distinguishes it from both the named species as well as from all other species of the genus. Most of the specimens are oblong or lingulate of nearly equal breadth in the whole length of the frond, only at the base and usually also at

Fig. 6. *Punctaria glacialis.* From the east side of Koldewey Island. 2 : 3.

the upper end narrower. Most of the specimens were dried, but some fragments are preserved in alcohol; one of these, which was fructifying, had a thickness of 130—140 μ, another sterile was 77—95 μ thick.

The outer cells are as a rule somewhat smaller than the inner, and the structure thus most resembles that of the genus *Punctaria*

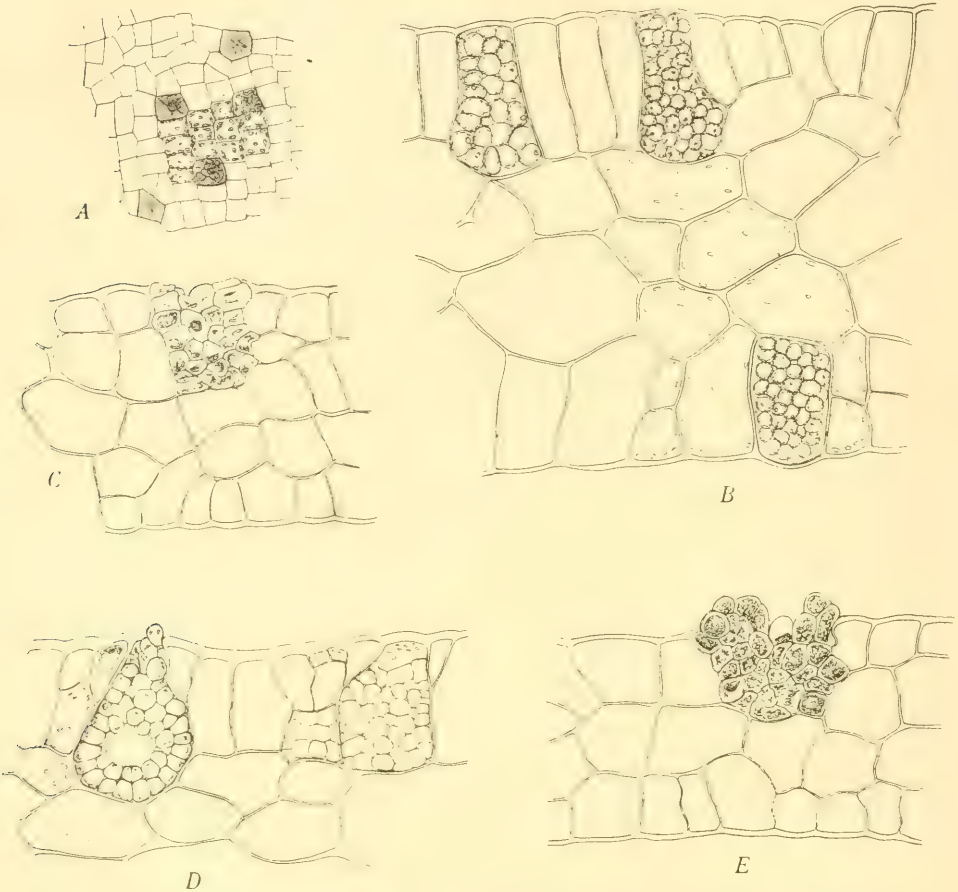


Fig. 7. *Punctaria glacialis.* *A,* part of frond seen from the surface; the shaded cells are sporangia. 200 : 1. *B—E,* transverse sections of fronds with unilocular sporangia. 340 : 1.

in the sense of J. Agardh (1896, p. 4). The frond is usually 4 to 5 cells thick. The cells contain numerous small disc-shaped chromatophores.

Some plants contain rather numerous sporangia which are all unilocular. Seen from the face they have nearly the same form and size as the vegetative cells, or they are a little more rounded. In transverse sections of the frond they appear often enlarged in-

wardly, a result of the growth of the sporangium and the surrounding cells after the formation of the former and often combined with cell-divisions of the latter (fig. 7 *B, D*). Strange to say, the zoospores had not developed normally but had formed a cell wall without having been set free, and the older sporangia thus became filled with closely packed polygonal cells, which gradually became rather poor in contents and might sometimes suggest the structure of plurilocular sporangia (fig. 6, *C*). Not seldom the older sporangia are open and the cells derived from the abortive zoospores are prominent above the surface of the frond (fig. 6, *D, E*), but normally developed and emptied sporangia have not been met with. Sometimes the zoospores do not fill the sporangium but leave an empty place in the middle of it (fig. 6, *D*). It may also happen that the upper part of the cell has not participated in the formation of zoospores.

Notwithstanding that this species differs from the other hitherto described species of the genus *Punctaria* by the want of hairs, I think it unnecessary to remove it from that genus. It is noteworthy that two other arctic members of the same family are also entirely devoid of hairs, namely *Omphalophyllum ulvaceum* and *Phæosaccion Collinsii*. Gathered in the end of August and the beginning of September.

Loc. Along Koldewey Island; Danmarks Havn; Baadskæret; bay off Vesterdalen, 4 to 11 meters depth.

Omphalophyllum K. Rosenv.

35. **O. ulvaceum** K. Rosenv.

K. Rosenvinge (1893) p. 873, (1898 I) p. 73; Jónsson (1904) p. 34.

The collection contains a large specimen of this arctic species, no doubt the largest hitherto found; it measures 28 cm. in greatest diameter, 16 cm. in greatest radius. It was sterile in the beginning of September. A small fragment without indication of locality was also sterile.

Loc. Along Koldewey Island.

Fam. *Elachistaceæ.*

Elachista Dub.

36. **E. fucicola** (Vell.) Aresch.

K. Rosenvinge (1893) p. 878, (1898 I) p. 74; Jónsson (1904) p. 35.

A few specimens occur attached to *Halosaccion ramentaceum* and *Punctaria glacialis*. They belong to the f. *typica* and had unilocular sporangia in August.

Loc. Bay off Vesterdalen.

Leptonema Reinke.

37. **L. fasciculatum** Reinke.

K. Rosenvinge (1893) p. 879; Jónsson (1904) p. 35.
Elachista fasciculata (Reinke) Gran, K. Rosenvinge (1898 I) p. 35.

Attached to *Lithothamnion glaciale*, mostly f. *subcylindrica* K. Rosenv., some filaments f. *uncinata* Reinke.

Loc. Entrance to the harbour.

Fam. *Ectocarpaceæ*.

Ectocarpus Lyngb.

38. **E. (Pylaiella) littoralis** (L.) Lyngb.

K. Rosenvinge (1893) p. 881, (1898 I) p. 75; Jónsson (1904) p. 35.

Found in various localities, mostly loose and in company with other loose algæ, in particular *Stictyosiphon tortilis*. Also found attached to stipes of *Alaria*. The latter specimens were very branched with secund branches, the others had often opposite branches. Unilocular sporangia were met with in plants collected in July and August.

Loc. East Side of Koldewey Island; along Cape Bismarck Peninsula; Danmarks Havn; bay off Vesterdalen, at most 4 meters; Cape Amélie, in clumps in the ice.

39. **E. ovatus** Kjellm. var. **tenuis** K. Rosenv.

K. Rosenvinge (1898 I) p. 77; Jónsson (1904) p. 37.

Small ca. 1 mm. high plants were found epiphytic on *Turnerella Pennyi* and *Lithothamnion glaciale*. They bear plurilocular sporangia which are mostly alternate or secund; opposite sporangia however also occur. The upright filaments are often unbranched (comp. Jónsson l. c.).

Loc. Danmarks Havn, and the entrance to the harbour.

40. **E. maritimus** (Kjellm.) K. Rosenv. comb. nov.

Chætophora maritima Kjellman (1877) p. 51, pl. V fig. 15—16.
Pilinia maritima (Kjellm.) K. Rosenv. (1893) p. 932.

In company with *Calothrix scopulorum* and other littoral algæ a small, branched filamentous alga was met with, occurring partly in a rather elongated partly in a shorter and denser form. The latter agrees pretty well with *Chætophora maritima* Kjellm., which has been referred by me to the genus *Pilinia*. On the other hand the more elongated plants remind one so much of *Ectocarpus lucifugus* Kuckuck, which has been so carefully described by its author (Kuckuck 1897, p. 35, pl. XI—XII), that the question arises whether it has been legitimate to refer this plant to the Chlorophyceæ. It is in reality very imperfectly known in regard to the cell-contents

and to the reproduction. Thus, the zoospores seem never to have been observed. The colour was yellow-green in the dried specimens from West Greenland I have examined, and according to Kjellman the colour of the cell-contents is brownish-green (fusco-viride) (l. c. p. 51). An examination of specimens from West Greenland and from Spitzbergen (communicated by Kjellman) showed really that the cells contained no starch and that the cell-wall did not consist of cellulose, the walls of the empty sporangia only staining violet by chlor-iodide of zinc. There is thus reason to believe that the alga in question is not a Chlorophycea but a Phæophycea, and as the more elongated plants in the material from East Greenland much resemble *Ectocarpus lucifugus* Kuck. the plant must be in that case a species of *Ectocarpus* related to *E. lucifugus*. On account of the good state of preservation (alcohol) of the material from North-East Greenland it was easy to see that the cells contain a parietal chromatophore like that described by Kuckuck. The plants had unilocular sporangia agreeing with those described by me in *Pilinia maritima* (1893 fig. 43) and with those of *Ectocarpus lucifugus* (l. c.); they were only a little smaller than the latter, namely 20—24 μ long, 9—10 μ broad, while the sporangia in Kuckuck's plants were 30—35 μ long and 11—15 μ broad.

As the more elongated and the denser plants undoubtedly belong to the same species, and as the denser form fully agrees with *Chætophora maritima* Kjellm., the species must retain Kjellman's specific name but it must be referred to the genus *Ectocarpus*. It is beyond doubt that the species is nearly related to *E. lucifugus* Kuck., and the resemblance is so great that there is reason to ask if these two species might not be identical. There seems however to be at least one distinctive character, some of the branches in *E. maritimus* terminating in hairs or hair-like filaments consisting of narrower and longer cells with scarcer and less coloured contents, as in several species of *Ectocarpus,* while such hairs are wanting in *E. lucifugus* according to the express statement of Kuckuck (l. c. p. 35) and to what I found on examining original specimens sent by Prof. Kuckuck. In the plants from North-East Greenland, however, the hairs were only fully developed in the specimens with short and dense branches.

This species much resembles the fresh-water alga *Pleurocladia lacustris* A. Br. (comp. Wille (1895) and Klebahn (1895)) and seems to be related to it. In my opinion, the genus *Pleurocladia* cannot be maintained as distinct from *Ectocarpus;* the species named must therefore be called *Ectocarpus lacustris* (A. Br.) nob.

Loc. Vestre Havnenæs.

Fam. *Myrionemaceæ.*

Myrionema Grev.

41. **M. foecundum** (Strömf.) Sauv.

Sauvageau (1898) p. 10; Børgesen (1902) p. 426.
Phycocelis foecunda Strömfelt (1888) p. 7.

A small *Myrionema* which seems referable to this species was met with in the upper end of a young *Alaria* in close company with *Phæostroma pustulosum*. The hairs were provided with a sheath at the base, and were 4—5 μ thick. The sporangia which showed here and there a few longitudinal divisions were 7—9 μ broad.

Loc. Along Cape Bismarck Peninsula.

Sorapion Kuck.

42. **S. Kjellmani** (Wille) K. Rosenv.

K. Rosenvinge (1898 I) p. 95.

Some crusts of this species agreeing with the formerly collected specimens from Greenland were met with growing on *Lithothamnion*-crusts. They were up to 4 mm. in diameter and bore empty unilocular sporangia which were scattered over the surface of the frond. Sterile specimens undoubtedly of the same species were found on *Turnerella Pennyi*.

Loc. Danmarks Havn; off Baadskæret.

Lithoderma Aresch.

43. **L. fatiscens** (Aresch.) emend. Kuckuck.

Kuckuck (1894) p. 238; K. Rosenvinge (1893) p. 901, (1898 I) p. 97; Jónsson (1904) p. 39.

This species is common, forming more or less extended crusts on the stones, often confluent so that the stones are covered with a continuous brown crust which easily loosens from the stone on drying. The crust is often fairly thick, e. gr. 30 cells thick and more. Some of the specimens collected in the end of August (or perhaps also in the beginning of September) showed plurilocular sporangia, as described by Kuckuck (l. c. p. 238 fig. 11 A), partly young partly fairly well developed, however scarcely fully ripe. This agrees with what I have found in specimens from Scoresby Sound (1898 I p. 98).

Loc. Danmarks Havn; entrance to the Harbour; along Vestre Havnenæs, ca. 38 meters.

Fam. *Sphacelariaceæ.*

Chætopteris Kütz.

44. **Ch. plumosa** (Lyngb.) Kütz.

K. Rosenvinge (1893) p. 903, (1908 I) p. 99; Jónsson (1904) p. 40.

Only a few badly developed and sterile specimens were met with.

Loc. Danmarks Havn; bay off Vesterdalen; Cape Amélie, in clumps in the ice, April.

Sphacelaria Lyngb.

45. **S. racemosa** Grev. var. **arctica** (Harv.) Reinke.

K. Rosenvinge (1893) p. 904, (1898 I) p. 100; Jónsson (1904) p. 40.

A couple of well-developed but sterile specimens have been found at Cape Bismarck Peninsula. Specimens found in the harbour in August had young unilocular sporangia sitting solitary on short 1—3-celled stalks, which were as a rule monosiphonous, more rarely two in one stalk.

Loc. East Side of Koldewey Island; along Cape Bismarck Peninsula; Danmarks Havn, very scarce.

C. Chlorophyceæ.

Fam. *Phyllosiphonaceæ.*

Ostreobium Born. et Flah.

46. **O. Queketti** Born. et Flah.

K. Rosenvinge (1893) p. 906, (1898 I) p. 101.

Occurs frequently in old shells of various bivalves (*Mya, Saxicava*), but also met with in *Lithothamnion foecundum*. It is well-developed and has often the characteristic swellings described by Bornet and Flahault. These swellings often reach considerable dimensions and are then filled with a granular green matter, but I cannot state anything about their significance. The colour is always green. Transverse walls do not occur.

Loc. East Side of Koldewey Island; entrance to the harbour; along Vestre Havnenæs, 19—47 meters; off Baadskæret 38 meters.

Fam. *Cladophoraceæ.*

Acrosiphonia (J. Ag.) Kjellm.

47. **A. hystrix** (Strömf.) Jónss.

Jónsson (1904) p. 46.

Spongomorpha hystrix Strömfelt (1886) p. 54.

Cladophora arcta γ, hystrix K. Rosenv. (1893) p. 907.

A fragment of an *Acrosiphonia* which seems to belong to this species has been met with. The filaments are 154—175 μ thick and are partly composed of rather short cells, only twice as long as broad. They are much like *A. hystrix* f. *debilis* (K. Rosenv.), only a little thinner (comp. Jónsson l. c. p. 48).

Loc. Danmarks Havn.

A. sp.

Some of the samples contain fragments of another species of *Acrosiphonia* in small quantities. They occur together with several loose algæ and have undoubtedly also been loose. Owing to their small quantity and their incomplete and sterile condition they are scarcely determinable. The filaments are 50—90 μ thick; hooked branches do not occur. A complete specimen, possibly belonging to the same species, was met with on a stone dredged at Cape Bismarck Peninsula. Its filaments were up to 121 μ thick. The cells were in this specimen, as well as in the loose ones, several times as long as broad, and rhizoidal branches were abundant. The last-named specimen was also sterile.

Loc. East Side of Koldewey Island; along Cape Bismarck Peninsula; bay off Vesterdalen.

Chætomorpha Kütz.

48. Ch. Melagonium (Web. et Mohr) Kütz.

K. Rosenvinge (1893) p. 917, (1898 I) p. 104; Jónsson (1904) p. 51.

Most of the specimens in the collection seem to have been loose. Some of these specimens are very vigorous, about 1 mm. in diameter and consist of cells which are one to two diameters long, while others are much thinner, from 100 μ up to 300 μ in diameter, and composed of cells which are 3 to 4 diameters long. As there is so great a break between these two forms, one might be inclined to think that they represent two different species, but the specimens being on the whole rather scarce in the collection, and the species being very variable in breadth also in other arctic regions (comp. K. Rosenvinge 1898 p. 104), I judge it preferable to consider the thin filaments as an extremely thin form of the same species. It might be named f. *tenuis*. The thinnest specimens approach in breadth to the thickest filaments of *Chætomorpha tortuosa;* they differ however in having much more numerous nuclei, viz.

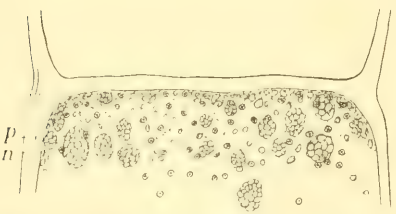


Fig. 8. *Chætomorpha Melagonium* f. *tenuis*. Upper end of a cell, showing nuclei, *n*, pyrenoids, *p*, and stroma starch. 200 : 1.

one to several hundreds (fig. 8), while *Ch. tortuosa* has ca. 20 nuclei in each cell (K. Rosenvinge 1893 p. 917).

The species seems to attain a greater thickness in high latitudes than farther south. According to Kjellman (1877 p. 56) it also reaches at Spitzbergen a diameter of ca. 1 mm., while its maximum diameter is otherwise stated to be 800 μ on the West coast of Sweden (Areschoug (1850) p. 202), 700 μ in the North Sea (Hauck 1885 p. 438) and 500 μ on the New England coast (Farlow 1881 p. 46).

In one gathering only it was found attached to a stone. These filaments had a diameter of at least 400 μ.

Loc. East Side of Koldewey Island; Danmarks Havn.

Fam. *Chætophoraceæ.*

Arthrochæte K. Rosenv.

49. **A. penetrans** K. Rosenv.

K. Rosenvinge (1898 I) p. 111.

This peculiar epi- and endophytic alga, which seems not to have been found by others since it was described in 1898, is rather frequently met with in older fronds of *Turnerella Pennyi,* in particular on discoloured spots. The plants fully agree with those from Scoresby Sound. The epiphytic crusts are in great measure polystromatic. Numerous sporangia, mostly empty, were found in plants collected in September.

Loc. East Side of Koldewey Island; Danmarks Havn.

50. **A. phæophila** sp. n.

Thallus endophyticus e filis irregulariter ramosis inter fila thalli *Symphyocarpi strangulantis* repentibus compositus. Fila primaria horizontalia ramosa, ramos breves verticales etiam emittentia; fila nonnunquam in massam pseudoparenchymaticam confluentia. Cellulæ subcylindricæ aut magis rotundatæ ad subglobosæ, longitudine diametro æquantes vel ad duplo longiores, lat. 9—15 μ, chromatophorum pyrenoide uno vel duobus instructum continentes. Pili articulati laterales vel terminales filis repentibus et erectis impositi, inferne 5·5—6·5 μ crassi. Sporangia obovata ad subglobosa in filis repentibus vel erectis lateralia aut terminalia, nonnunquam plura dense aggregata, apice dehiscentia, long. 14—25 μ, lat. 10—21 μ.

This new species has only been met with in small quantity in a few dried crusts of *Symphyocarpus strangulans* growing on a *Lithothamnion*-crust. The filaments creep irregularly between the cells of the host, in particular horizontally, in accordance with the small thickness of the host. They are often much branched, particularly in a horizontal direction, but short erect filaments are also given

off. Sometimes, when the filaments are much branched, they are united to pseudoparenchymatous bodies. I am uncertain whether the plant may also be partly epiphytic. Here and there vigorous hairs, slowly tapering upwards, occur; they show one or two transverse walls, and their cells, in particular the upper, have not much contents. The vegetative cells almost certainly contain one parietal chromatophore, which however could not be distinguished in the dried plants; on the other hand one or two pyrenoids were often distinctly visible (fig. 9, *A*, *I*). Besides the pyrenoid-starch, the chromatophores contained abundant stroma-starch. The cell-wall gave intense cellulose-reaction with chlor-iodide of zinc. The position of the sporangia is different; they may be terminal on the erect filaments and lateral, sessile, on the same and on the creeping filaments. Once I have seen a terminal and a subterminal sporangium on the end of a filament, (fig. 9 *G*). The sporangia observed were all emptied through a split in the upper part of the cell-wall. They have undoubtedly contained swarm-cells, but whether asexual zoospores or gametes, it is impossible to say.

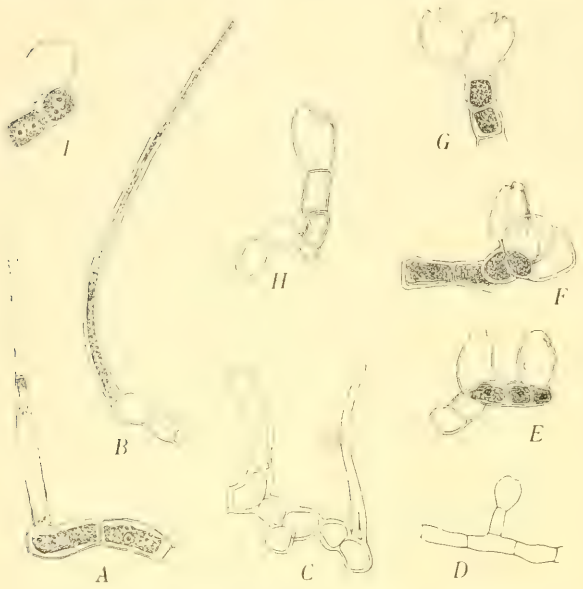


Fig. 9. *Arthrochæte phæophila.* *A,* creeping filament with lateral hair. *B,* terminal hair. *C,* branched filament with hair. *D,* creeping filament with erect filament bearing a sporangium. *E,* creeping filament with two sessile sporangia. *F,* erect filament, given off from a creeping one, bearing four sporangia, seen from above. *G,* filament with a terminal and a subterminal sporangium. *H,* erect filament with a terminal sporangium. *I,* lateral sporangium. 350 : 1.

I was at first inclined to refer this alga to the genus *Pilinia* which it somewhat resembles in its mode of growth. It is distinguished however from this genus by the presence of pyrenoids which, as far as known, are wanting in *Pilinia.* Moreover, it differs by the pluricellular hairs. Such hairs were certainly pointed out in *Pilinia maritima,* but as this plant has turned out to be a species of *Ectocarpus*, as shown above (p. 123), hairs are now not to be found

in any species of *Pilinia*. By these hairs it resembles *Arthrochæte penetrans*, and as the sporangia and the structure of the vegetative cells are also similar, it might be referred to the same genus. It is distinguished from the species named by the arrangement of the filaments and the broader, often nearly globular sporangia. The differences in the structure of the vegetative frond are probably partly dependent on the differences in structure of the host plants. In this respect the new species is too little known, owing to the scarce material.

Loc. Off Baadskæret.

Epicladia Reinke.

51. **E. Flustræ** Reinke.

K. Rosenvinge (1898 I) p. 115.

The determination of the plants referred to this species is not quite sure, as they were not fructiferous. They agreed with Reinke's description and figures; the creeping filaments were partly confluent, forming a membrane, and the cells showed here and there foldings inward of the cell-wall. Found on *Delesseria sinuosa* and *Desmarestia aculeata*.

Loc. East Side of Koldewey Island; Danmarks Havn.

Gomontia Born. et Flah.

52. **G. polyrrhiza** (Lagerh.) Born. et Flah.

K. Rosenvinge (1893) p. 907, (1898 I) p. 101.

In old dead greenish crusts of *Lithothamnion lævе* and in shells of *Mya* and *Saxicava*, in the latter case together with other perforating algæ (*Conchocelis, Ostreobium*) and as a rule in lesser quantity than these. Found in 19 meters depth, at least. With sporangia in the beginning of September.

Loc. Entrance to the harbour; along Vestre Havnenæs.

Pseudendoclonium Wille.

53. **P. submarinum** Wille.

Wille (1901) p. 29.

In company with *Calothrix scopulorum* and other littoral algæ a small alga was found which agreed well with Wille's description and figures, as to the mode of growth, dimensions and structure of the cells. The elongated cells were 5—6 μ broad; the cells contained a parietal chromatophore.

Loc. Vestre Havnenæs.

Fam. *Ulothricaceæ.*

Ulothrix Kütz.

54. U. flacca (Dillw.) Thur.

K. Rosenvinge (1893) p. 935; Wille (1901) p. 18; Jónsson (1904) p. 54.

At the upper end of a young *Alaria* some filaments of a *Ulothrix* were met with which must be referred to this species. The swarm-cell producing parts of the filaments were curved in the manner characteristic of the species and consisted of low cells undoubtedly producing gametes[1]. The filaments were comparatively thin, the fertile parts only reaching 33 μ in diameter. The cells often contained only one pyrenoid, probably in connexion with the small thickness of the filaments.

Loc. Along Cape Bismarck Peninsula.

55. U. scutata Jónsson.

Jónsson (1904) p. 57.

This species seems to be common within the region explored. However, I am only sure of the determination of the specimens from one locality, as I have seen only in these the basal part characteristic of the species. Most of the specimens from the other localities are dried. At the base the filaments were 5—7 μ thick, and the cells in the lower part of the filaments were frequently up to 4 times as long as broad.

Loc. East Side of Koldewey Island. Further, uncertain as to the determination from dredging along Cape Bismarck Peninsula, Danmarks Havn and Baadskæret.

56. U. consociata Wille.

Wille (1901) p. 25; Jónsson (1904) p. 60.

The North-East Greenland specimens agree with Wille's description; only they were rather thin. Young sterile plants were only 7—7·5 μ thick near the base, older filaments 10·5 μ, fertile filaments 12·5 μ thick. The filaments are often decumbent at the base and form rhizoids there. Sometimes two filaments were found coalesced near the base. The apical cell is rounded. — It was found growing on *Enteromorpha prolifera* in the tidal region.

Loc. Vestre Havnenæs, September.

[1] In stating (1893 p. 935—36) that I have found this species with zoospores in West Greenland, I have not intended to say anything about the question whether the swarm-cells were asexual zoospores or gametes. Probably they were gametes (comp. Wille (1901) p. 21).

Fam. *Ulvaceæ.*

Enteromorpha (Link.)

57. **E. prolifera** (O. F. Müll.)

K. Rosenvinge (1893) p. 960; Jónsson (1904) p. 66.

It is with hesitation that I have referred to this species some specimens collected in the littoral region. They are rather much branched, thin, with still thinner branches. The arrangement of the cells in longitudinal series is sometimes tolerably distinct, the new cell-walls being mainly perpendicular to the axis of the frond, sometimes indistinct or wanting. The cells are angular with somewhat rounded edges, much as in the typical form of *E. intestinalis,* but only 7—9 μ in diameter. The membrane of the frond is 11—12 μ thick, the cell-wall is not thickened on the inner side. A great number of very young plants were met with. Some of the large plants looked as if they had wintered and later on produced new branches. No "trabeculæ" were observed in the cavity of the frond.

In view of the great difficulty of determining species of *Enteromorpha* much stress cannot be laid on the determination of the above-mentioned specimens; nor shall I enter into the question whether *E. prolifera* is specifically distinct from *E. intestinalis.*

Loc. Vestre Havnenæs, September.

Fam. *Protococcaceæ.*

Chlorochytrium Cohn.

58. **Ch. inclusum** Kjellm.

K. Rosenvinge (1893) p. 963, (1898 I) p. 119; Jónsson (1904) p. 69.

Very common in *Turnerella Pennyi.*

Loc. East Side of Koldewey Island; Danmarks Havn; off Baadskæret a. 28 meters.

59. **Ch. Schmitzii** K. Rosenv.

K. Rosenvinge (1893) p. 964, (1898 I) p. 119; Jónsson (1903) p. 338.

Very common in *Cruoria arctica* and in *Petrocelis polygyna.*

Loc. Off Baadskæret and along Vestre Havneaæs, ca. 28 meters.

D. Cyanophyceæ.

Fam. *Rivulariaceæ.*

Calothrix Ag.

60. **C. scopulorum** (Web. et Mohr) Ag.

K. Rosenvinge (1893) p. 966, (1898 I) p. 121; Jónsson (1904) p. 70.

Well developed filaments, in a great measure with hormogonia. In the littoral zone.

Loc. Vestre Havnenæs, September.

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9—5—1910.

V.

FUNGI TERRESTRES FROM NORTH-EAST GREENLAND

(N. OF 76° N. LAT.)

COLLECTED BY THE "DANMARK-EXPEDITION"

DETERMINED

BY

C. FERDINANDSEN

WITH PL. IX

1910

INTRODUCTION.

The material of earth-fungi brought home by the "Danmark Expedition" was collected by A. Lundager between 76° and 77° N. L., partly on the mainland, partly on the southern Koldewey Island[1], and is very scanty, as was to be expected. In all 16 species are represented in the collection, of which however only 11 can be identified with any certainty. The greater number of these, 7 species namely, have been earlier noted from Greenland, and of the remainder *Calvatia arctica* n. sp. and *Calvatia cyathiformis* (Bosc.) Morg. have already, as will appear from the text, also been found by previous collectors. The same holds good in all probability for *Cortinarius collinitus* (Pers.) Fr. The fourth species hitherto not noted from Greenland, *Russula* cfr. *R. integram* (L.) Fr., belongs to the commonest North European fungi and is also known from Arctic regions.

Russula cfr. *R. nitidam* Fr. is new for the east coast; on the other hand, *Scleroderma vulgare* Fr. and *Lycoperdon favosum* (Rostk.) Bonord. are dropped from its flora (cfr. text).

As was to be expected beforehand, the species found are such as grow — or are able to grow — on barren and little sheltered places in temperate latitudes; there is much agreement especially between this small high-northern fungus-flora and that of our own heaths.

As mentioned above, it has not been possible to determine all the fungi with certainty to their species; many characters namely are wiped out on preserving the material — chiefly the colours, next also the whole appearance of the living fungus, which is an essential, sometimes indeed necessary condition for a correct determination of species. This is helped out somewhat for the species which have been drawn in colours by the artists of the Expedition; but we can naturally not expect to find just the mycologically important characters illustrated in such sketches. A completely satis-

[1] A single, indeterminable species was collected by Dr. Lindhard on Maroussia.

factory picture of the fungal flora of a region will on the whole only be obtained, when a specialist visits the country and himself collects his material.

For friendly assistance in the examination of the *Gasteromyceteae* collected I am much indebted to Dr. LADILAUS HOLLÓS of Kecskemét in Hungary and my friend cand. WINGE of Copenhagen.

Agaricineae.

Cortinarius Fr.

Cortinarius (Myxacium) collinitus (Pers.) Fr. — Epicr. p. 274.

No. 270a (coloured drawing): bog north of Thermometerfjæld, 4—6—07; No. 355: near the large lake, 9—8—07; No. 1911: Danmarks Havn, 16—7—08; No. 1916: Basiskæret, 16—7—08.

On the largest and best preserved specimens (No. 355) the belted structure of the stalk is still to be seen; the other specimens are less typical, but undoubtedly belong within the range of this species, which is very variable. In microscopical regards they are quite the same.

This species, which seems comparatively common, has probably been brought home from Greenland on earlier occasions, without its being possible to determine the specimens; cfr. ROSTRUP: Fungi Groenlandiae orientalis etc., Medd. om Grønland XXX, p. 15: "In collectionibus .... Agaricaceae .... indeterminabiles e generibus *Russulae* .... et *Cortinarii* inventae sunt".

Cortinarius sp.

No. 380: Cape Bismarck, 14—8—07.

Galera Fr.

Galera Hypnorum (Batsch) Fr. — Syst. Myc. I, p. 267.

No. 33a (coloured drawing): near the large lake, 1—8—07; No. 1766: in damp moss, 18—7—08.

Cystidia bottle-shaped, usually with a small knob or bud on the neck. In the material from Julianehaab I have found conical cystides, which however showed a tendency to swell out above into knobs; on the whole this species seems to contain several types in regard to the form of the cystidia.

"Seems to be one of the commonest Agaricaceae occurring in Greenland" (Rostrup: Tillæg til Grønlands Svampe, Medd. om Grønland III, p. 597).

Inocybe Fr.

Inocybe lacera Fr. — Syst. Myc. I, p. 257.

No. 48a: Koldewey Island, 13—8—06.

A covering of sand, containing protonema threads, small mosses, a very small *Juncus* plant and withered stumps of older, still surrounds the somewhat knob-shaped, swollen basal part of the stalk.

This fungus thrives well on sandy, naked ground; the author has found it on such a locality on heaths in Jutland. — Noted by Rostrup from Danmarks Ø (Ost-Grønlands Svampe, Medd. om Grønland XVIII, p. 7).

Lactarius Pers.

Lactarius rufus (Scop.) Fr. — Epicr. p. 247.

No. 48b: Koldewey Island, 13—8—06; No. 381b: Thermometerfjæld, 17—8—07.

The anatomical examination of the trama shows that the fungus is a *Lactarius* or a *Russula*. There is nothing stated regarding the milk contents; but most fortunately *Lactarius rufus* belongs to the fungi, which resist excellently the influence of the preserving fluid, so that it is easily recognised even in alcohol.

The fungus is noted by Rostrup from Danmarks Ø (Øst-Grønlands Svampe, Medd. om Grønland XVIII, p. 8); it is of rather common occurrence on Danish heaths.

Naucoria Fr.

Naucoria sp. sc. N. lapponica Fr. — Hym. Eur. p. 263.

No. 1935: Bog near Danmarks Havn, 16—7—08.

A small specimen (stalk ca. 2 cm. high, pileus $1^1/_2$ cm. broad), with quartz grains firmly attached to the surface of the pileus. Spores ellipsoidal, 8—10 μ × 5—6 μ, light-yellow with oil-drops. — Colour of the pileus is now dark-brown, but on drying yellow spots come to view which have been very apparent in the fresh state; this is indicated by a note in the journal: "honey-fungus". The pileus has thus been covered by bright yellow scales, and the pellicle has been viscous; add to this, that the lamellae are toothed at the edge and with decurrent teeth, and it becomes very probable that we have *N. lapponica* Fr. before us. — Unfortunately, no microscopic characters have been included in the diagnosis of this species, which makes the identification very difficult. — Rostrup notes *N. lapponica* Fr. from Cape Stewart (Øst Grønland Svampe p. 7).

Omphalia Fr.

Omphalia umbellifera (L.) Fr. — Elench. I, p. 22.

No. 381 a (coloured drawing): Thermometerfjæld, 17—8—07; No. 1936: bog near Danmarks Havn, 16—7—08 (Honey-fungus).

As the drawing and the term "honey-fungus" indicate, the fungus has a beautiful yellow colour in the living condition (the form *Ag. chrysoleucus* Pers., which is common in high mountains and in the Arctic).

"Seems to be the most commonly occurring and most widespread of the Agaricineae in Greenland" (ROSTRUP: Fungi Groenlandiae, Medd. om Grønland III, p. 528). — Cf. also ROSTRUP: Øst-Grønlands Svampe, Medd. om Grønland XVIII, p. 7, DUC D'ORLÉANS: Croisière océanographique etc. Botanique p. 12. — N. HARTZ's note, that the fungus is common on damp spots in the heath in Scoresby Sound (Øst-Grønlands Svampe l. c.) agrees well with the fact, that on Danish heaths it is also chiefly bound to moist spots between the *Calluna*-tufts, where the author has even found it submerged.

Omphalia umbellifera (L.) Fr. var. ad **O. rusticam** Fr. vergens.

No. 360: fungi on fairly dry ground on S. E. side of the Varde-Ridge, 11—8—07; chocolate-brown, the small specimen with a light spot in the middle.

From the typical *O. umbellifera* this form differs by its dark colour and by somewhat narrower, more crowded lamellae; in these characters it approaches to *O. rustica* Fr., which species along with *O. umbellifera*-forms is united by PERSOON to the species *Agaricus ericetorum*. Both species (*umbellifera* and *rustica*) are found on Danish heaths.

Omphalia sp.

No. 991: Basiskæret 20—6—08; in rough dried moss and as stiff as wood.

The badly preserved condition makes a certain determination impossible.

Russula Fr.

This is one of the genera in which the separation of the species is often very difficult, in fact almost impossible in alcohol material when the plants have not been collected and labelled by a specialist. A certain amount of knowledge of the shades of colour of the spores and of the taste (smell) of the flesh is in fact an indispensable condition for the determination of the species — and of these characters the first can be only with difficulty, the last impossibly recognised after treatment with alcohol. The determinations given must therefore merely be regarded as approximate.

Russula sp. cfr. **R. integram** (L.) Fr. — Epicr., p. 360.

No. 333b (coloured drawing): near the large lake, 1—8—07; No. 353 (coloured drawing): no locality noted.

Of these specimens No. 353 (deep-red, strongly tuberculated at the margin, stalk somewhat faintly yellowish) certainly comes nearest to the true *R. integra* Fr.; No. 333b seems more distant, to judge from the coloured drawing, especially in the yellow stalk — and is in any case not *R. integra* sensu Friesii. — "Plures occurrunt ambiguae formae, praecipue *R. integra* coloris varietatibus fallax". (Sacc. Syll. V, 469).

Russula integra is "in Europa boreali ex vulgatissimis" and is further noted from Siberia and the Bellot Islands (81° 41′ N. L.) (Sacc. Syll. V, p. 475).

Russula sp. cfr. **R. nitidam** (Pers.) Fr. — Epicr. p. 361.

No. 400 (coloured drawing): Basiskæret, 20—8—07.

The pileus has a characteristic, deep-blue colour with red-mauve spots. If the lamellae are yellowish — and they certainly seem to be so — the fungus belongs in the neighbourhood of the species named.

Rostrup (Fungi Groenlandiae, Medd. om Grønland III, p. 529) gives *R. nitida* from Upernivik.

Russula sp.

No. 270b (coloured drawing): In pool N. of Thermometerfjæld, 4—6—07.

The plant itself is not to be found in the collection, and the coloured drawing does not give sufficient information to make a determination of the species possible.

Tubaria Fr.

Tubaria furfuracea (Pers.) Fr. — Syst. Myc. I, p. 262.

No. 374: Near the shore E. of Thermometerfjæld, 12—8—07. On the slope in a dried-up water-course. Moorland.

Small, but typically developed specimens with several concentric circles of clay-coloured scales along the margin of the pileus.

Rostrup does not mention this fungus from East Greenland (only from Upernivik and Disco); but it has probably been found later at Cape Bismarck; cf. Duc d'Orléans: Croisière océanographique etc., Botanique, p. 12.

Agaricaceae indeterminatae.

The remainder of the Agaricaceae collected, in all three species, must be taken together under this designation, as not even a deter-

mination of the genus is possible in these cases; for this, so far as the species A (Nos. 1293 and 1294) is concerned, the too little developed condition stands in the way, and the material of the second species, B, (Nos. 70 and 454) was already damaged by larvae and frost on collecting. Lastly, the third species, C, (Nos. 382 and 383) belongs to such a difficult generic group, that a determination from the available, very sparse material would be quite indefensible. — For the sake of completeness the fungi in question are noted — with the collector's and a few other additions — as an appendix to the above-given list.

A. No. 1293: Maroussia 20—7—08; Dr. LINDHARD found these fungi in an eskimo ruin, the kitchen-corner, deep under the surface. No. 1294: Like the foregoing, only seen here.

The specimens found are quite small, the largest 1 cm. high with pileus just formed. Brownish. Grows on a swampy soil, chiefly of moss.

B. No. 70: Fungi in wet moss under Thermometerfjæld. No. 454: Basiskæret, 25—8—07, taken in the frozen condition, later thawed and put in alcohol.

The spores are rough, hyaline; the flesh is almost entirely eaten away by larvae. *Russula?*

C. No. 382: Thermometerfjæld, 17—8—07, damp grass. No. 383: the same, lot of rain on preceding days.

These specimens have characteristic, edged spores; but as nothing is noted regarding the colour of the spores, a certain determination of the genus cannot be made. If the spores were red, the fungus has to be referred to *Entoloma* (or *Leptonia*); if they were brown, on the other hand, the species will belong to *Inocybe*. — There is absolutely no resemblance between the material of small, dark fungi preserved in alcohol and the coloured drawing of No. 382, which shows a very large, fine, grey-lilac, silky fungus and seems to have indications of brown spores. — *Inocybe?*

Gasteromyceteae.

Calvatia Fr.

Calvatia cyathiformis (Bosc) Morg. — North American Fungi, Journ. Cincinati Soc. Nat. Hist. XII, p. 168.

Synonyms:

Lycoperdon cyathiforme Bosc, Berlin Mag. 1811 V p. 87, t. VI fig. 11 A, B.

Bovista lilacina Berk. & Mont., Hook. Lond. Journ. Vol. IV 1845.

Lycoperdon lilacinum (Berk.) Mass., Massee: Monographia Lycop. nr. 10.

Lycoperdon lilacinum (Berk. & Mont.) Speg., Fungi Argent., p. 197, nr. 321.

Lycoperdon fragile Vitt., Monogr. Lyc. p. (36) 80, 1842.

Calvatia fragilis (Vitt.) Morg., North American Fungi in Journ. Cincinati Soc. Nat. Hist. XII, p. 168.

Lycoperdon Bovista Vitt., Fungi. Mang. p. 264, t. XXXIII, fig. II G et E.

Lycoperdon pseudolilacinum Speg., Fungi Guaran. p. 45, nr. 94.

No. 1906, Hvalrosodde Aug. 1906; No. 79, Hvalrosodde 16—6—07; No. 133, Hvalrosodde 13—6—07.

This fungus is very cosmopolitan in its distribution (Asia, Africa, America, Europe) and also occurs in this country, mostly on heath and downs. — Of the specimens brought home No. 1906 is about to shed its spores and it is distinctly seen, that the brown, chequered periderm is bursting irregularly, *Calvatia*-like; in the other specimens, which probably have wintered, only the bowl-shaped basal part remains; in No. 79 this has a diameter of ca. 7 cm. All the specimens are almost sessile, stalky-contracted below and with wrinkled-grooved basal part. The spore-mass is dark-brownish, with purple shade; under the microscope the spores are distinctly warted, sometimes with a small pedicel, yellowish brown, 5—6 μ diam.; threads of the capillitium have almost the same diameter as the spores and a slightly darker colour. The loose tissue in the quite weakly developed, sterile foot-part has a lilac sheen. There could scarcely be any doubt from these characters, that these fungi belonged to *Calvatia cyathiformis,* and the well-known specialist on the Gasteromyceteae, Dr. Ladislaus Hollós of Hungary, to whom I sent No. 1906, has also confirmed my determination of that specimen.

On going through the East Greenland collections in the Botanical Museum of Copenhagen I came across a specimen of the above-mentioned species, collected at Cape Dalton by C. Kruuse and published in Rostrup's "Fungi Groenlandiae orientalis ...." in Medd. om Grønland XXX, p. 115, under the name of *Lycoperdon favosum* (Rostk.) Bonord[1]. The specimen in question consists only of the persistent basal part of the fungus, which in this case is but little typical, almost disc-shaped and with *Geaster*-like, retroverted lobes on the margin. Further, the colour is lighter than the type. A section through the (short and but little distinct) stalk of the fruit-body shows, however, the loose, lilac-coloured tissue which is so characteristic of *C. cya-*

[1] Bot. Zeit. 1857, p. 595; Sacc. Syll. VII p. 121. In Bot. Centralbl. 1902, Beil. p. 4 (extra) Oudemans has given the same specific name to a newly founded species; according to a generally applied rule this last species should be called *Lycoperdon Oudemansii.*

thiformis. Also in regard to gleba and microscopic characters there is full agreement with this species.

Calvatia arctica Ferdinandsen et Winge sp. n.

Peridio fere habitum *Sclerodermatis aurantii* aemulante, subreniformi-globoso, inferne stipitiformi-protracto indeque plicato, lat. ad 6 cm., alt. circ. 3 cm., ± radicato. Exoperidio tenui, superne verrucis eximie pyramidatis, lineolis horizontalibus parallelis ornatis, obsesso, nonnumquam magis irregulariter areolato-caelato, inferne, secundum limitem satis distinctum, granuloso — primo albo, ad maturitatem fungi ochraceo. Endoperidio crasso, irregulariter dehiscente, fragili. Gleba peridium fere totum explente, initio alba, matura griseobrunneola, levissime olivaceo-tincta, basi sterili pallida, parvo-cellulari, partem infimam stipitiformem peridii tantum occupante, instructa. Basidiis obovato-clavatis, 14—16 μ × 7—8 μ, sterigmatibus tenuibus, usque 18 μ long., suffultis. Sporis globosis, 4·5 μ — 5·5 μ diam, minute papillatis, uniguttulatis, tenuiter tunicatis, flavidulis, ad maturitatem verrucis hyalinis, perexiguis, deciduis exasperatis. — Floccis diametro fere sporarum (raro ad 7½ μ lat.), iisdem subconcoloribus, nonnumquam dichotome ramosis.

Hab. ad terram in tractu litoreo Groenlandiae orientalis, Lat. bor. c. 77°.

No. 241, in a bog, 19—7—07; No. 1803, Lille Snenæs, 9—7—08, common in heath-bogs, damp *Carex*- and *Eriophorum*-pools.

As the above diagnosis shows (see also Plate IX), this fungus has a very characteristic external appearance, not unlike certain forms of *Scleroderma aurantium* (Vaill.) Pers.[1] The specimens collected were unripe, but on going through the collections of the Botanical Museum of Copenhagen in order if possible to find material for comparison, I was successful in obtaining a ripe specimen of the fungus, collected on the Liverpool Coast, Hurry Inlet (C. Kruuse). The latter is noted in Rostrup's Fungi Groenlandiae orientalis etc., Medd. om Grønland XXX, p. 115, under the name of *Lycoperdon favosum* (Rostk.) Bonord.. This last species seems from the description hardly distinct from *Calvatia caelata* (Bull.) Morg., and in his work "Die Gasteromyceten Ungarns" p. 163, Hollós also gives the two species as synonyms. — It is not possible now, however, to bring the above-described species in under the true *Calvatia caelata*; the gleba-mass,

[1] In "Tillæg til Grønlands Svampe", Medd. om Grønland III p. 601, Rostrup states, that *Scleroderma vulgare* Fr. is "common in heaths", citing a note of N. Hartz, written on a label to a specimen from Vajgattet. The specimen in question, however, is no *Scleroderma,* but belongs to the *Lycoperdaceae* and is most likely nothing but a young *Calvatia arctica.* After this *Scleroderma vulgare* Fr. (= *S. aurantium* (Vaill.) Pers.) is not recorded from the East coast.

namely, is greyish chocolate-brown, and the spores are slightly warted (4·5—5·5 μ diam., light-yellow); further, the threads of the capillitium have nearly the same diameter as the spores. These microscopic characters point towards *C. cyathiformis*, without however permitting identification with this species; for this also the sculpture of the periderm and the light colour stand in the way.

I then sent the specimen from the Liverpool Coast (A), as also a true *C. cyathiformis*, (No. 1906) to Dr. Hollós, who very kindly subjected these fungi to a closer investigation and returned them with the following remarks: „Exemplar A ist entschieden kein *Calvatia caelata* (Bull.) Morg. .... Auch nicht *Calvatia cyathiformis* (Bosc) Morg. — Ich kenne den Pilz nicht. In meiner reichen Sammlung befindet sich kein solches Exemplar, mit dem ich Exempl. A vergleichen könnte."

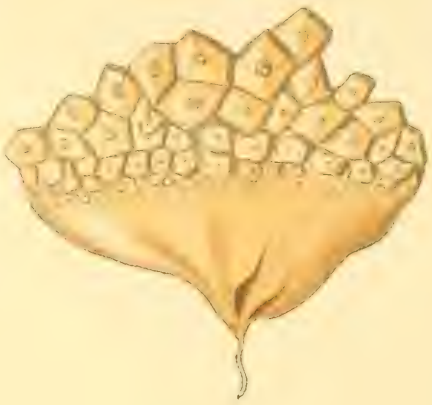
On an accompanying, analytical drawing Dr. Hollós has written: *Calvatia* sp.? — and in this genus the fungus should certainly be placed. It seems, from the information given, to be rather widely distributed in East Greenland.

EXPLANATION OF PLATE IX.

Calvatia arctica Ferd. & Wge sp. n.

Fig. 1. Habitus of a young fungus, nat. size (after a specimen in alcohol).
Fig. 2. Part of the peridium of a ripe fungus, from the outside, nat. size (after a dried specimen).
Fig. 3. The same, from the inner side.
Fig. 4. Spores, $\frac{1000}{1}$.
Fig. 5. Basidia, $\frac{1000}{1}$.
Fig. 6. Threads of the capillitum, $\frac{1000}{1}$.

1



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CALVATIA ARCTICA sp. n. FERD et WGE

Dansk Repr

A Winge ad nat. del

VI.

SYSTEMATIC LIST OF FUNGI (MICROMYCETES) FROM NORTH-EAST GREENLAND

(N. OF 76° N. LAT.)

COLLECTED BY THE "DANMARK-EXPEDITION" 1906—1908

DETERMINED

BY

J. LIND

WITH PLATE X

1910

INTRODUCTION.

The following list of fungi is mainly the result of my examination of the vascular plants, collected by Mr. LUNDAGER; only a few of them belong to Captain J. P. KOCH and Mr. FREUCHEN'S collections. Only very few specimens have been collected expressly for the sake of the fungi themselves, and accordingly the majority of the fungi found belong to the less conspicuous species.

Most of the species are already known from Greenland and have been mentioned in E. ROSTRUP'S publications in earlier volumes of "Meddelelser fra Grønland"; 4 of the 65 species are new to science, and 18 of them have not formerly been found in Greenland.

For the rest my report comes close to C. H. OSTENFELD and ANDR. LUNDAGER'S "List of vascular plants", so that I may refer to their list for the names of authors of the host-plants etc.

List of the collecting places, arranged from north to south.

Hyde Fjord	83° 15′ N. Lat.
Mallemukfjeld	80° 10′ —
Lambert Land	79° 8′ —
Ymers Nunatak	77° 24′ —
Cape Marie-Valdemar c.	77° 20′ —

Germania Land: Rypefjeld, Hvalrosodde, Dove Bugt, Lille Snenæs, Snenæs, Stormkap, Harefjeld, Danmarks Havn, Termometerfjeld, Basiskær, Cape Bismarck,
arranged from N. W. to S. E. 77° — 76° 43′ N. Lat. and 21° — 17° 30′ W. Long.

Maroussia Island	76° 39′ N. Lat.	—	18° 43′ W. Long.
St. Koldewey Island ca.	76° 30′ —		18° 50′ —

List of papers dealing with Fungi of northern East Greenland.

FERDINANDSEN et WINGE: Champignons, in Duc d'Orléans, Croisiere oceanographique dans la mer du Grønland en 1905. Resultats scientifiques. Bruxelles. 1908.

FUCKEL: Pilze, in Die 2te deutsche Nordpolarfahrt. Bremen 1872.

Rostrup: Fungi Groenlandiae. Meddelelser om Grønland III. Kjøbenhavn 1888.
— Tillæg til Grønlands Svampe. — — III. — 1891.
— Østgrønlands Svampe. — — XVIII. — 1894.
— Fungi Groenlandiae orientalis. — — XXX. — 1904.
Saccardo: Sylloge fungorum. vol. I—XVIII. Patavii 1882—1906.

Myxomycetes.

1. **Licea brunnea** Preuss. Sacc. Syllog. VII, p. 405.
Sporidiis cinnamomeis, globosis, 4—5 μ diam.

Loc. On Owls disgorging, Lille Snenæs $^{2}/_{9}$ 07.

Phycomycetes.

2. **Physoderma Hippuridis** Rostrup. Sacc. Syllog. XI, p. 250.

Loc. On living stems of *Hippuris vulgaris*, Danmarks Havn $^{15}/_{7}$ 08.

Note. Has hitherto only been noticed in Greenland and in the Isle of Funen. (cf. Rostrup: Mykologiske Meddelelser VIII. Botanisk Tidsskrift Bd. 22, p. 254).

Ustilagineae.

3. **Cintractia Caricis** (Pers.) Magn. Syn: *Ustilago Caricis* (Pers.) Fuck. Sacc. Syll. VII, p. 464.

Loc. On *Cobresia* (*Elyna*) *Bellardi*, Termometerfjeld. $^{15}/_{8}$ 07.

Uredineae.

4. **Melampsora arctica** Rostrup. Sacc. Syll. VII, p. 594 & IX, p. 926.

Loc. Both on the upper and lower sides of leaves of *Salix artica*. Harefjeld $^{10}/_{7}$ 07, Danmarks Havn $^{18}/_{7}$ 08, Lille Snenæs $^{12}/_{7}$ 08.

5. **Puccinia Cardamines-bellidifoliae** Dietel. Sacc. Syll. XVI, p. 275. Sydow: Monographia Uredinearum. Vol. I, p. 510.
Sporidiis 33—36 μ × 17 μ.

Loc. On living leaves of *Cardamine bellidifolia*, Lille Snenæs $^{2}/_{9}$ 07.

Gymnoasceae.

6. **Gymnoascus Reessii** Baranetzky. Sacc. Syll. VIII, p. 823.

Loc. On *Lemming* excrement, Termometerfjeld, Sept. 07.

Note. New for Greenland.

Pezizeae.

7. **Mollisia advena** Karst. Sacc. Syll. VIII, p. 352.

Loc. On *Eriophorum polystachyum* f. *elegans*, Danmarks Havn $^{14}/_{7}$ 08.

Note. New for Greenland.

8. **Mollisia atrata** (Pers.) Karst. Syn: *Pyrenopeziza atrata* (Pers.) Fuck. Sacc. Syll. VIII, p. 354.

Loc. On stems of *Potentilla emarginata*, Renskæret $^{20}/_{7}$ 08.

9. **Pyrenopeziza Karstenii** Sacc. Syll. VIII, p. 367. Syn: *Mollisia graminis* Karsten *non Peziza graminis* Desm.

Loc. On dead leaves of *Aira caespitosa*, Danmarks Havn $^{16}/_{7}$ 08; and of *Poa*(?), Lille Snenæs $^{22}/_{6}$ 08.

10. **Geopyxis Ciborium** (Vahl) Sacc. Syllog. VIII, p. 64.

Ascis clavatis 200 μ (p. sp. 100 μ) $\times$ 12 μ; paraphysibus hyalinis, ramosis, septatis ascos superantibus, apice sensim ad 5 μ incrassatis; sporidiis hyalinis, continuis, eguttulatis, 15—17 μ $\times$ 6 μ.

I have compared the specimens found with Flora danica tab. 1078 fig. 1, they have not so long and slender a stalk as shown in the picture, but they are similar as regards size and shape (see tab. X fig. 5).

Loc. Termometerfjeld $^{4}/_{6}$ 07 among mosses.

Sticteae.

11. **Naevia diminuens** (Karst.) Rehm. Syn: *Phacidium diminuens* Karst. Sacc. Syll. VIII, p. 721.

Loc. On dead leaves of *Hierochloa alpina*, Cape Marie-Valdemar. $^{15}/_{8}$ 06.

12. **Naevia pusilla** (Lib.) Rehm. Sacc. Syll. VIII, p. 662. Syn: *Trochila juncicola* Rostrup. Sacc. Syll. VIII, p. 732.

Loc. On dead leaves of *Luzula arcuata* var. *confusa*. Lamberts Land $^{14}/_{6}$ 07. (Koch.)

Phacidieae.

13. **Rhytisma salicinum** (Pers.) Fries. Sacc. Syll. VIII, p. 753.

Loc. Living leaves of Salix arctica, Danmarks Havn $^{20}/_{5}$ 08.

Hysterineae.

14. **Lophodermium arundinaceum** (Schrad.) Chev. Sacc. Syll. II, p. 975.

Loc. On leaves of *Festuca ovina*, Termometerfjeld $^{28}/_{7}$ 07; *Festuca ovina* var. *brevifolia* Danmarks Havn $^{15}/_{7}$ 08.

15. **Lophodermium arundinaceum** (Schrad.) Chev. var. **alpinum** Rehm. Sacc. Syll. II, p. 795.

Ascis 80 μ × 12 μ; paraphysibus filiformibus; sporidiis 40—48 μ × 4 μ.

This var. differs distinctly and noticably from the principal species by its shorter and more open perithecia and by its spores, which are up to 4 μ broad.

Loc. On leaves of *Poa glauca*, Danmarks Havn, $^{16}/_{7}$ 08.

Erysiphaceae.

16. **Erysiphe graminis** deC. Sacc. Syllog. I, p. 19.

No perithecies, only conidies (*Oidium monilioides* Link. Sacc. Syllog. IV, p. 46) are to be found.

Loc. On living leaves of *Poa cenisia*. Snenæs $^{12}/_{7}$ 08.

17. **Sphaerotheca Humuli** (deC.) Burr. var. **fuliginea** (Schlecht.) Salmon (A monograph of the Erysiphaceae. New York 1900).

This fungus is the same as described by Juel under the name of *Sphaerotheca Drabae* (Några mycologiska notiser. Botaniska Notiser 1890. Sacc. Syllog. IX, p. 365).

Rostrup (Ascomyceter fra Dovre. Kria. Vid. Selsk. Forh. 1891 No. 9, p. 6) and Salmon (A monograph of the Erysiphaceae p. 51 & p. 57) however agree in classifying it under *Sphaerotheca Humuli* in spite of its different appearance.

Loc. On *Braya purpurascens* (hosp. nov.). Lille Snenæs $^{24}/_{6}$ 08 and Trekroner $^{27}/_{6}$ 08.

Melanommaceae.

18. **Melanomma Dryadis** Johans. Sacc. Syllog. IX, p. 804.

Sporidiis fuscidulis, 3-septatis, 21—22 μ × 8—10 μ.

Loc. On dead leaves of *Dryas octopetala*, Hyde Fjord, $^{14}/_{5}$ 07 (Koch).

Note. New for Greenland.

Sphaerellaceae.

19. **Ascospora graminis** spec. nov.

Mycelio repente, effuso, subpersistente, hypophyllo, fusco e hyphis torulosis, ramosis, septatis composito; Peritheciis superficialibus, applanato convexis, sparsis 80—100 μ diam., medio perforatis; ascis fasciculatis, globoso-ovatis, sessilibus, apice crasse tunicatis, aparaphysatis, octosporis, 24—40 μ × 13—17 μ; sporidiis ellipticis, inaequi lateralibus, granulosis, hyalinis, conglobatis, 15—16 μ × 4 μ. (Look tab. X fig. 1 & 2).

Loc. On dead leaves of *Poa glauca* and *Poa abbreviata*, Lille Snenæs, Sept. 08.

20. **Carlia rhytismoides** (Babingt.) Kuntze. Syn: *Laestadia rhytismoides* (Berk.) Sacc. Syllog. I, p. 424.

Loc. On leaves of *Dryas octopetala*, Hydefjord $^{18}/_{5}$ 07 (Koch) and Danmarks Havn $^{6}/_{7}$ 08.

21. **Mycosphaerella pachyasca** (Rostrup) Vgr. Syn: *Sphaerella pachyasca* Rostr. Sacc. Syll. IX, p. 613.

Loc. On dead leaves and stems of *Campanula uniflora*, Danmarks Havn $^{8}/_{7}$ 08; *Cardamine bellidifolia*, Bugten $^{8}/_{7}$ and Danmarks Havn $^{16}/_{7}$ 08; *Cerastium alpinum*, Hvalrosodde $^{24}/_{8}$ 06. *Draba arctica*, Hvalrosodde $^{16}/_{7}$ 07; *Epilobium latifolium*, Rypefjeld $^{27}/_{6}$ 08 (Freuchen) and Lille Snenæs $^{11}/_{7}$ 08; *Oxyria digyna*, Danmarks Havn $^{8}/_{7}$ 08; *Papaver radicatum*, Rypefjeld $^{6}/_{7}$ 08, Danmarks Havn $^{17}/_{7}$ 08, Elven $^{6}/_{7}$ 07; *Ranunculus pygmaeus*, Danmarks Havn $^{8}/_{7}$ 08.

22. **Mycosphaerella Tassiana** (de Not.) Johans. Syn: *Sphaerella Tassiana* de Not. Sacc. Syllog. I, p. 530.

Loc. On dead leaves of *Aira caespitosa* and var. *arctica*, Danmarks Havn $^{28}/_{7}$ 07; *Arctagrostis latifolia*, Danmarks Havn $^{14}/_{7}$ 08; *Carex incurva*, Rypefjeld $^{6}/_{7}$ 08 (Freuchen); *Carex misandra*, Hvalrosodde August 06; *Carex pulla*, Termometerfjeld $^{28}/_{7}$ 07; *Carex rigida*, Rypefjeld Juny 08; *Eriophorum Scheuchzeri*, Danmarks Havn $^{14}/_{7}$ 08 and Vester Elv $^{17}/_{7}$ 07; *Festuca ovina*, Termometerfjeld $^{28}/_{7}$ 07 and St. Koldewey $^{13}/_{8}$ 06; *Festuca ovina* var. *brevifolia*, Danmarks Havn $^{10}/_{8}$ 07; *Glyceria angustata*, Hyde Fjord $^{18}/_{5}$ 07 (Koch) and Mallemukfjeld $^{11}/_{6}$ 07 (Koch), Danmarks Havn $^{20}/_{7}$ 08 & $^{10}/_{8}$ 07 and Maroussia $^{21}/_{7}$ 08; *Glyceria maritima* f. *vilfoidea*, Danmarks Havn $^{4}/_{9}$ 07; *Luzula nivalis*, Stormkap $^{19}/_{8}$ 06; *Phippsia algida* (hosp. nov.) Danmarks Havn $^{28}/_{7}$ 08; *Poa abbreviata*, Hvalrosodde $^{24}/_{8}$ 06; *Poa cenisia*, Cape Marie-Valdemar $^{15}/_{8}$ 06 and Danmarks Havn $^{14}/_{7}$ 08; *Poa pratensis* Hvalrosodde Aug. 1906.

23. **Mycosphaerella Wichuriana** (Schroet.) Johans. Syn: *Sphaerella Wichuriana* Schroet. Sacc. Syllog. I, p. 530.

Loc. On withering leaves of *Festuca ovina*, Termometerfjeld $^{28}/_{7}$ 07; *Glyceria angustata*, Danmarks Havn $^{9}/_{8}$ 07; *Poa cenisia*, Cape Marie-Valdemar $^{15}/_{8}$ 06; *Carex nardina*, Cape Marie-Valdemar $^{15}/_{8}$ 06.

Pleosporeae.

24. **Didymosphaeria Dryadis** (Fuck.) Berl. & Vogl. Sacc. Syllog. IX, p. 733, non *Didymosphaeria Dryadis* (Speg.) Wt.

Ascis 160 μ × 32 μ; sporidiis 35—36 μ × 16—17 μ.

Loc. *Dryas octopetala*, Danmarks Havn $^{6}/_{7}$ 08.

25. **Venturia chlorospora** (Ces.) Karst. Sacc. Syllog. I, p. 586.

Loc. *Salix arctica*, Danmarks Havn $^{10}/_{8}$ 07.

26. **Leptosphaeria Andromedae** (Awd.) Sacc. Syllog. II, p. 49. Syn: *Leptosphaeria hyperborea* (Fuck.) Berl. & Vogl.

Loc. On dead leaves of *Cassiope tetragona*, Hvalrosodde $^{25}/_{8}$ 06.

27. **Leptosphaeria caricinella** Karst. Sacc. Syllog. II, p. 65.

Peritheciis 260 μ diam.; ascis 110—152 μ × 24—28 μ; sporidiis 44—52 μ × 12—13 μ, 3-septatis, ad septa constrictis, strato mucoso obvolutis; paraphysibus numerosis, hyalinis.

Does not seem to have been found again since the Swedish Polar Expedition first obtained it in Spitzbergen August 10th 1868 (Karsten: Fungi in insulis Spitsbergen et Beeren Eiland collecti. Öfv. of Kgl. Vetensk. Akadem. Förh. 1872 No. 2, p. 91—108) on the same host-plant. Saccardo (l. c.) wants to classify it under *Leptosphaeria vagans* Karsten, yet I cannot but consider it a good species. My measurements are in complete accordance with those stated by Karsten (Perith 150—200 μ diam.; asci 125—140 μ × 28—34 μ; spor. 38—52 μ × 10—15 μ), on the other hand Berlese (Icon. fungorum tab. LVI fig. 1) found them much smaller (asc. 70—90 μ × 16—20 μ; spor. 35—38 μ × 6—7 μ).

Loc. On dead leaves of *Carex pulla*, Termometerfjeld $^{28}/_{7}$ 07. (Look tab. X fig. 3).

28. **Leptosphaeria epicarecta** (Cook) Sacc. Syllog. II, p. 65.

Loc. On *Carex misandra*, Danmarks Havn $^{17}/_{7}$ 08.

29. **Leptosphaeria gigaspora** Nssl. Sacc. Syllog. II, p. 65.

Peritheciis c. 400 μ diam.; ascis 140 μ × 24—28 μ; paraphysibus hyalinis; sporidiis ellipsoideis, curvulis, flavis, 5-septatis, ad septa non constrictis, 56—63 μ × 16 μ.

Loc. On dead leaves of Carex nardina, Termometerfjeld $^{22}/_{7}$ 07.

Note. New for Greenland.

30. **Leptosphaeria Hierochloae** Ouds. Sacc. Syllog. IX, p. 793.

Ascis 100—115 μ × 14—16 μ; sporidiis 28—31 μ × 8—10 μ, 3—5-septatis.

Loc. On dead leaves of *Hierochloa alpina*, Danmarks Havn $^{12}/_{7}$ 08.

Note. New for Greenland.

31. **Leptosphaeria microscopica** Karst. Sacc. Syllog. II, p. 59.

Peritheciis c. 120 μ diam.; ascis 72—88 μ × 14—17 μ; sporidiis 28—32 μ × 6—8 μ, flavis, curvulis, 3-septatis.

Loc. *Alopecurus alpinus*, Danmarks Havn $^{16}/_{7}$ 08; *Poa abbreviata*, Termometerfjeld $^{28}/_{7}$ 07; *Glyceria maritima*, Danmarks Havn $^{4}/_{9}$ 07.

32. **Leptosphaeria vagans** Karsten. Sacc. Syllog. II, p. 59.

Peritheciis depressis, subastomis, c. 240 μ diam.; ascis subcylindricis, apice rotundatis, deorsum breve truncato-stipitatis 92—115 μ × 25—32 μ; paraphysibus filiformibus, hyalinis, guttulatis; sporidiis oblongato-ellipticis, 3-septatis, loculo secundo et tertio leviter tumidis, ad septa constrictis, curvulis, flavis, circulo gelatinoso, hyalino circumdatis, 34—36 μ × 10—13 μ.

Loc. On *Glyceria angustata*, Danmarks Havn $^{10}/_{8}$ 07; *Phippsia* (*Calabrosa*) *algida* (hosp. nov.)

Note. New for Greenland.

33. **Pleospora Arctagrostidis** Ouds. Sacc. Syllog. IX, p. 879.
Ascis 120 μ × 32 μ; sporidiis 36—38 μ × 12—13 μ, 5—7-septatis.

Loc. On leaves of *Arctagrostis latifolia*, Danmarks Havn $^{14}/_{7}$ 08.

Note. New for Greenland.

34. **Pleospora arctica** Fuck. Sacc. Syllog. IX, p. 882. *Non Pleospora arctica* Karsten = *Pleospora Karstenii* Berl. & Vogl.

Peritheciis 350 μ × 240 μ; ascis oblongis, curvatis, 100—128 μ × 23—28 μ; paraphysibus numerosis, hyalinis, multiguttulatis; sporidiis initio flavis, dein saturate brunneis, 34—36 μ × 14—16 μ, 6-septatis, medio constrictis, parte superna parum tumidiore, longitudinaliter 1—2-septatis.

This is very probably the same fungus, as classified by Rostrup (Fungi groenlandiae 1888) under *Pleospora herbarum* (Pers.) Rabenh. with the remark, that there is no difference between *Pl. arctica* and *Pl. herbarum*. In my opinion there are, however, several differences between these two fungi: the sporidia of *Pl. arctica* are smaller and with age they grow darker than those of *Pl. herbarum*.

Loc. On *Epilobium latifolium*, Termometerfjeld July 1907 and Lille Snenæs $^{11}/_{7}$ 08.

35. **Pleospora Cerastii** Oudemans (Contributions à la Flore mycologique de Nowaja Semlja, Verslag. en Meded. d. Kon. Akad. v. Wetensch. Afd. Natuurk. 3. Del, II, Amsterdam 1885 p. 146). Ascis 100 μ × 20 μ, crasse tunicatis; sporidiis flavis, 28—32 μ × 12—14 μ, 4—6-septatis, septisque 1—3 longitudinaliter divisis.

Saccardo (Syllog. II, p. 285) considers it to be a variety of *Pyrenophora chrysospora*, with which opinion I cannot agree as f. inst. *Pyr. chrysosp.* is quite constant in having 7 dissepiments in every spore, this fungus always having less.

Loc. On dead stems of *Stellaria longipes*, Cape Marie-Valdemar $^{16}/_{8}$ 06.

Note. New for Greenland.

36. **Pleospora deflectens** Karst. Sacc. Syllog. II, p. 266.
Sporidiis 26—29 μ × 12 μ, 7-septatis.

Loc. On *Alopecurus alpinus*, Stormkap $^{18}/_{6}$ 06; *Poa abbreviata*, St. Koldewey $^{13}/_{8}$ 06.

37. **Pleospora discors** (Mont.) Ces. & de Not. Sacc. Syllog. II, p. 270.

Peritheciis sparsis, epiphyllis, globosis, vertice erumpentibus, ostiolo papillaeformi; ascis 8-sporis, 140 μ × 28—32 μ, crasse tunicatis; sporidiis oblongatis, utrinque obtuse rotundatis, inaequilateralibus, transverse 5—6-septatis, in longitudine 1 divisis, initio flavis dein atris opacis, 35—42 μ × 12—15 μ, interdum strato gelatinoso, 10—12 μ crasso cinctis.

Loc. *Alopecurus alpinus*, Lamberts Land $^{14}/_{6}$ 07 (Koch); *Poa cenisia*, St. Koldewey $^{13}/_{8}$ 06.

38. **Pleospora Drabae** Schroeter. Sacc. Syllog. II, p. 253.

Ascis 82—132 μ × 20—28 μ; sporidiis flavo-olivaceis, dein fuligineis, 25—33 μ × 12—17 μ, 5—7-septatis, ad septum medium constrictis, longitudinaliter 1-septatis.

Loc. On dead leaves and stems of *Braya purpurascens*, Lille Snenæs $^{29}/_{6}$ 08; *Draba alpina*, Rypefjeld $^{2}/_{7}$ 08, Vestre Havnenæs $^{7}/_{7}$ 07, Danmarks Havn $^{10}/_{8}$ 07; *Draba hirta* var. *arctica*, Harefjeld $^{24}/_{7}$ 07, Termometerfjeld $^{27}/_{6}$ 07, Lille Snenæs $^{29}/_{6}$ 08; *Draba fladnizensis*, Trekroner $^{27}/_{6}$ 08, Lille Snenæs $^{22}/_{6}$ 08; *Draba alpina* var. *glacialis*, Danmarks Havn $^{8}/_{7}$ 08.

39. **Pleospora papaveracea** (de Not.) Sacc. Syllog. II, p. 243.

Ascis 110—124 μ × 24 μ; paraphysibus hyalinis filiformibus; sporidiis 33—36 μ × 12—17 μ, transversim 4-septatis, septisque 3 longitudinaliter divisis.

Loc. On *Papaver radicatum*, Lamberts Land $^{14}/_{6}$ 09. (Koch).

40. **Pleospora Karstenii** Berl. & Vogl. Syn: *Pleospora arctica* Karsten. Sacc. Syllog. II, p. 271 non *Pleospora arctica* Fuck.

Peritheciis c. 240 μ diam.; ascis 108 μ × 30 μ; sporidiis 36 μ × 16 μ, 7-septatis.

Loc. On *Poa abbreviata*, Termometerfjeld $^{28}/_{7}$ 07.

41. **Clathrospora Elynae** Rbh. Syn: *Pleospora Elynae* (Rbh.) Ces. & de Not. Sacc. Syllog. II, p. 273.

Loc. On *Luzula confusa*, Cape Marie-Valdemar $^{15}/_{8}$ 06.

42. **Clathrospora pentamera** (Karst.) Berlese. Syn: *Pleospora pentamera* Karst. Sacc. Syllog. II, p. 266.

This fine species, which is easily recognized, and which seems to be common in this neighbourhood, was first described by P. A. Karsten (Fungi in insulis Spitsbergen et Beeren Eiland. Öfv. of Kgl. sv. Vet. Ak. Förh. 1872 No. 2) as a *Pleospora;* the spores have, however, as described and figured by Berlese (Icones Fungorum vol. II, p. 31 & tab. XLVI), all their cells in the same plane, and accordingly it is a *Clathrospora.* When seen from the front, the sporidia are oblong pear-shaped with four cross-walls and one longitudinal wall in the three middle compartments without any narrowing, when seen from the side the crosswalls only are visible, not the longitudinal wall, and then they have distinct narrowings. Their colour is most frequently yellow like honey, but may grow almost black with age. I most frequently found the sporidia somewhat larger than stated by Karsten, viz. 29—36 μ long, 15—17 μ broad and 9—12 μ thick.

Loc. *Alopecurus alpinus*, Dove Bugt $^{2}/_{5}$ 07; *Carex nardina*, Termometerfjeld $^{28}/_{7}$ 07 and Hvalrosodde $^{24}/_{8}$ 06; *Glyceria angustata*, Hyde Fjord $^{18}/_{5}$ 07 (Koch); *Hierochloa alpina*, Stormkap $^{19}/_{8}$ 06; *Poa abbreviata*, Termometerfjeld $^{28}/_{7}$ 07, Ymers Nunatak $^{17}/_{5}$ 08 (Freuchen); *Poa cenisia*, Danmarks Havn $^{14}/_{7}$ 08; *Poa glauca*, Lille Snenæs July 08 and Danmarks Havn $^{14}/_{7}$ 08.

43. **Pyrenophora chrysospora** (Nssl.) Sacc. Syllog. II, p. 285 & IX, p. 896.

Loc. *Campanula uniflora*, Snenæs $^{7}/_{7}$; *Cardamine bellidifolia*, Danmarks Havn $^{16}/_{7}$ 08; *Erigeron compositus*, Danmarks Havn $^{12}/_{7}$ 07 and $^{28}/_{7}$ 07; *Lesquerella arctica*, Lille Snenæs $^{29}/_{6}$ 08 and Snenæs Feltplads $^{26}/_{8}$ 08; *Potentilla pulchella*, Hyde Fjord $^{14}/_{5}$ 07 (Koch); *Ranunculus sulphureus* (hosp. nov. Lille Snenæs $^{29}/_{6}$ 08.

44. **Pyrenophora comata** (Nssl.) Sacc. Syll. II, p. 286.

Loc. On dead leaves and stems of *Armeria sibirica*, Hvalrosodde $^{2}/_{7}$ 08 and Danmarks Havn $^{9}/_{7}$ 08; *Oxyria digyna*, Danmarks Havn $^{8}/_{7}$ 08; *Papaver radicatum*, Cape Marie-Valdemar $^{15}/_{8}$ 06 and Stormkap $^{19}/_{8}$ 06; *Pedicularis hirsuta* and *Potentilla nivea*, Danmarks Havn July 1908; *Potentilla pulchella*, Maroussia $^{21}/_{7}$ 08 and Lille Snenæs $^{26}/_{6}$ 08; *Stellaria longipes*, Lamberts Land $^{14}/_{6}$ 07 (Koch) and Danmarks Havn July 1908.

45. **Pyrenophora filicina** nov. spec.

Peritheciis sparsis, erumpenti-superficialibus, globosis, majusculis, 300 μ diam., atris, coriaceis, superne setigeris, ostiolo breve conico; ascis oblongo-clavatis, stipite brevi, apice rotundatis et crasse tunicatis, 8-sporis, 88—110 μ $\times$ 25 μ; ascis paraphysibusque mox fluxilibus; sporidiis subdistichis oblongo-ovatis, rectis, transverse 5—6-septatis, medio constrictis, in longitudine 1—2-septatis, primo flavis demum fuscis et totis opacis, 28—34 μ $\times$ 15—17 μ. (See tab. X fig. 4).

Loc. On dead petioles of *Cystopteris fragilis*, Danmarks Havn $^{8}/_{7}$ 08.

46. **Pyrenophora paucitricha** (Fuck.) Berl. & Vogl. Sacc. Syllog. IX, p. 898.

The sporidia, measured and described by Fuckel (Die 2te deutsche Nordpolfahrt. I. Botanik, p. 23. Bremen 1872. (Tab. I fig. 3) have apparently not been quite ripe; besides olive-coloured sporidia of 26—30 μ in length and 10—12 μ in breadth and in every way corresponding to Fuckel's description, I have found other sporidia of significantly larger size, viz. 43—45 μ $\times$ 22 μ and of a black-brown colour. The capillaries of the perithecia are black-brown and septated.

Loc. On dead leaves of *Salix arctica*, Stormkap $^{19}/_{8}$ 06 and Lille Snenæs $^{24}/_{6}$ 08.

Gnomonieae.

47. **Gnomonia salicella** (Fries) Schroet. Syn: *Diaporthe salicella* (Fries) Sacc. Syllog. I, p. 622.

Loc. On dead twigs of *Salix arctica*, Danmarks Havn $^{16}/_{7}$ 08.

Sphaerioideae.

48. **Mycogala parietinum** (Schrad.) Sacc. Syll. III, p. 185.

Loc. On wood in the berth of Jarner, Danmarks Havn October 1907.

Note. New for Greenland.

49. **Ascochyta Dianthi** (A. & S.) Libert. Sacc. Syllog. III, p. 398 & X, p. 301.

Sporidiis utrinque obtusis, curvulis, 1-septatis, hyalinis, guttulatis, 15—21 μ × 4 μ.

Loc. On *Cerastium alpinum*, Harefjeld $^{24}/_{7}$ 07.

50. **Rhabdospora Drabae** (Fuck.) Berl. & Vogl. Sacc. Syllog. X, p. 391. Syn: *Phoma Drabae* Fuck., *Septoria Drabae* Rostrup, *Septoria semilunaris* Johans. Sacc. Syllog. X, p. 363.

It was first described by Fuckel as *Phoma Drabae* (Fuckel: Die 2. deutsche Nordpolfahrt in den Jahren 1869 und 1870. II. Abth. Botanik, p. 94. Bremen 1872) and figured in the same paper tab. I fig. 9. Both description and figures are again found in Oudeman's work (contributions à la flore mycologique de Nowaja Semlja p. 150, Amsterdam 1885). Rostrup classifies it as belonging to *Septoria* (Fungi groenlandiae, 1888 p. 572) and Berlese & Voglino calls it *Rhabdospora Drabae*.

Johanson's *Septoria semilunaris* (Svampar från Island. Öfv. of Kgl. Vet. Akad. Förh. 1884 No. 9 p. 173) ought to be classified in the same genus (formgenus) as it appears on dead stalks and leaves only. It is, however, impossible to find a constant difference between Johanson's and Fuckel's two fungi. According to the description the only difference should be, that the sporidia of *Rhab. Drabae* measure 22 μ × 2 μ and the sporidia of *Rhab. semilunaris* 10—15 μ × 3—5 μ; but Allescher (Allescher und Hennings: Pilze aus dem Umanakdistrict. Bibliotheca Botanica Heft 42, 1897 pag. 51), who has found *Rhab. semilunaris* on the same substratum as Johanson, viz. on dry stalks of the flowers of *Dryas*, gives the sizes of the sporidia as being 14—20 μ × 1·5—2·5 μ, and he has also found traces of a dissepiment in them. And if we examine a sufficient number of specimens, we find all possible transitions among them. So I consider it right to unite the two species (form-species) into one.

Septoria Vanhoffenii P. Henn (Allescher und Hennings l. c. p. 52), *Septoria nivalis* Rostrup (Fungi groenlandiae 1888) and *Septoria cerasticola* Rostrup (Islands Svampe. Botanisk Tidsskrift 1903) also seem to come very close to *Rhabdospora Drabae*.

In the size and shape of the sporidia (stylospores) they seem to be very much like *Rhabdospora groenlandica* (conf. Tab. X fig. 8—9—10) which will be mentioned later on, but *Rhab. Drabae* has

larger, collapsed perithecies and is only to be found on dicotyledonous plants, f. inst.: *Braya, Campanula, Cerastium, Draba, Dryas, Erigeron, Geranium, Parnassia, Plantago, Potentilla, Rumex* and *Veronica.*

Loc. *Braya purpurascens,* Lille Snenæs $^{26}/_{4}$ 08 and $^{29}/_{6}$ 08; *Campanula uniflora,* Snenæs $^{7}/_{7}$ 08; *Cerastium alpinum,* Hvalrosodde $^{24}/_{8}$ 06; *Draba alpina,* Rypefjeld $^{2}/_{7}$ 08; *Draba arctica,* Lille Snenæs $^{29}/_{6}$ 08; *Draba hirta,* Lille Snenæs $^{24}/_{6}$ 08; *Draba subcapitata,* Lille Snenæs $^{22}/_{6}$ 08.

51. **Rhabdospora groenlandica** nom. nov. Syn: *Septoria nebulosa* Rostrup. Sacc. Syllog. X, p. 385.

By Rostrup it is called *Septoria nebulosa* (Rostrup: Fungi groenlandiae 1888 p. 575); as it is, however, always found on dead leaves and stalks and never forms spots on living leaves, it ought to be called *Rhabdospora* according to the common method of nomenclature. The name *Rhabdospora nebulosa* is, however, preoccupied for another fungus, *Rhabdospora nebulosa* (Desm.) Sacc. Syllog. III, p. 589, so that I am obliged to find a new name for the above mentioned fungus.

It is very common on dead leaves of the *Monocotyledones.* There is no small difference in size between the separate sporidia, the longest I measured were 28 μ, the shortest 13 μ; still the greater number are 20—22 μ long and 2—3 μ broad; their shape is always that of a small crescent, spindle-shaped with both ends evenly and sharply pointed; its contents are most frequently slightly granulated and there are sometimes slight traces of a dissepiment in the middle. The perithecies are small, their diameter 80—120 μ, they are numerous and grouped in darkish oblong spots (see Pl. X fig. 9 & 10).

Loc. On *Carex nardina,* Termometerfjeld $^{22}/_{7}$ 07; *Carex pulla,* Basiskæret $^{15}/_{8}$ 07; *Carex rupestris,* Lille Snenæs $^{25}/_{6}$ 08 and $^{7}/_{7}$ 08; *Cobresia Bellardi,* Lille Snenæs $^{25}/_{6}$ 08 and Danmarks Havn $^{15}/_{7}$ 08; *Eutrema Edwardsii,* Øster Elv $^{8}/_{8}$ 07; *Iuncus biglumis,* Termometerfjeld $^{17}/_{8}$ 07; *Poa abbreviata,* Stormkap $^{14}/_{7}$ 08 and Danmarks Havn July 08; *Poa cenisia,* Danmarks Havn $^{14}/_{7}$ 08; *Poa glauca,* Lille Snenæs July 08 and Danmarks Havn $^{20}/_{7}$ 08.

52. **Kellermannia cercosperma** (Rostrup) Syn: *Septoria cercosperma* Rostrup, *Rhabdospora cercosperma* (Rostrup) Sacc. Syllog. X, p. 391, *Septoria caudata,* Karsten, *Rhabdospora caudata* (Karst.) Sacc. Syllog. III, p. 593.

Allescher mentions *Rhabdospora caudata* and *Rhabdospora cercosperma* as two different species, saying:

> "Saccardo sagt bei *Rhabd. cercosperma:* "Videtur vix differe a *Rhabd. caudata,* sporulis 2—3 septatis". Dem kann ich vorläufig nicht beistimmen, da die Perithecien der vielen untersuchten Exemplare nie "superficialia" sondern von der geschwärzten Oberhaut bedeckt, die Sporen auch viel kürzer

sind und stets des borstenförmigen Anhanges entbehren; allerdings habe ich die 2—3 Scheidewände, welche Rostrup angiebt, auch nicht beobachten können".

(Allescher & Hennings: Pilze aus dem Umanakdistrikt, Bibliotheca Botanica Heft 42, p. 52).

In reference to this I would say that Karsten has probably only described his *Septoria caudata* in Hedwigia 1884 as a new species because he did not know Rostrup's description of *Septoria cercosperma* in Sv. Vetensk. Akad. Förh. from the preceding year. Saccardo, Rostrup, Johanson and Vestergren also quite agree as to the identity of these two species. I consider it much more likely, that Allescher, having noticed neither the septa in the sporidia nor the cauda and having found them shorter than stated in the report and with different perithecia, was dealing with quite another fungus, which he wrongly called *Rhabd. cercosperma*, and I am most inclined to believe this to be *Rhabd. Drabae* (Fuck)[1] = *Septoria semilunaris* Johans. of which he says:

"Mir scheint der Pilz mit *Rhabd. cercosperma* identisch zu sein". (l. c. p. 52).

The spores (stylospores) of this species (form-species) are completly different from those of all other *Rhabdospora* and *Septoria*-species. At the base they are rounded, outwardly pointed and finally they end in a long capillary tail. When unripe they are furnished with oil-drops, when older with up to three dissepiments. The perithecia are of varying size yet larger than is common in the Sphaerioideae and collapsed, with protruding ostiolum (see especially Vestergren's excellent description and figures in: Eine arktisch-alpine *Rhabdospora*, Bih. till. Kgl. Vet. Akad. Handl. Bd. 26. Afd. III No. 12, 1900).

It does not, however, differ essentially from the form-genus *Kellermannia* Ell. & Ev. in Journ. of Mycology 1885 p. 153. Sacc. Syllog. X, p. 337, so that I must move it from *Rhabdospora* to *Kellermannia*. In this connection I may mention, that a fungus, which I found in *Jutland* on dead stalks of Rumex acetosa and which E. Rostrup classified for me as his *Rhabdospora cercosperma* (distributed in Kabat & Bubak Exsiccat: Fungi imperfecti exsiccati as No. 426), is identical with one found by Ove Rostrup, also on *Rumex acetosa*, near Copenhagen and published by E. Rostrup in: Mykologiske Meddelelser IX. Botanisk Tidsskrift vol. 26, p. 312 as *Kellermannia Rumicis* Fautr. & Lamb.

Still I do not venture to say — until I have had an opportunity of seing more material of this fungus, the sporidia, and perithecia of which according to Vestergren vary very much in size — if

the five species of *Kellermannia* (*K. yuccogena* Ell. & E., *K. Polygoni* Ell. & Ev., *K. Sisyrinchii* Ell. & Ev., *K. Rumicis* Fautr. & Lamb. and *K. cercosperma* (Rostr.) are identical, or if many different species can be distinguished.

Loc. On dead stems of *Polygonum viviparum*, Danmarks Havn $^{14}/_{7}$ 08.

53. **Stagonospora arenaria** Sacc. Syllog. III, p. 453.

Peritheciis 160 μ diam.; sporidiis 36—40 μ × 4 μ 3-septatis, hyalinis.

Loc. On dead leaves of *Poa abbreviata*, Termometerfjeld $^{28}/_{7}$ 07.

Note. New for Greenland.

54. **Coniothyrium Lesquerellae** spec. nov.

Peritheciis sparsis, e globoso-lenticularibus, subcutaneis, vix erumpentibus, tenuibus membranaceis, atris, majusculis c. 350 μ diam., ostiolo vix prominente pertusis; sporulis ut plurimum perfecte globosis, atro-fuscis, eguttulatis, 7—10 μ diam.

Loc. On dead stems of Lesquerella (Vesicaria) arctica, Harefjeld $^{10}/_{7}$ 07.

55. **Coniothyrium olivaceum** Bon. Sacc. Syllog. III, p. 305.

Sporidiis olivaceis, oblongatis, 5 μ × 1·5 μ.

Loc. *Campanula uniflora*, Snenæs $^{7}/_{7}$ 08.

56. **Diplodia Simmonsii** Rostrup (Report of the 2nd Norwegian Arctic Expedition in the Fram 1898—1902, No. 9, 1906).

Dead leaves may assume a black tinge from the attack of this fungus (Look tab. X fig. 6).

Loc. *Carex nardina*, *Hierochloa alpina* and *Luzula confusa*, Cape Marie-Valdemar $^{15}/_{8}$ 06.

Note. New for Greenland.

57. **Hendersonia arundinacea** (Desm.) Sacc. Syllog. III, p. 436.

Sporidiis flavo-olivaceis, guttulatis, 20—36 μ × 3—5 μ, 3-septatis.

Loc. *Arctagrostis latifolia*, and *Poa abbreviata*, Danmarks Havn $^{14}/_{7}$ 08; on the leaves of an undetermined sp. of grass, Maroussia $^{21}/_{7}$ 08.

Note. New for Greenland.

58. **Hendersonia Luzulae** West. Sacc. Syllog. III, p. 451 & X, p. 328.

Sporidiis olivaceis, 20—24 μ × 3 μ, 3-septatis.

Loc. On *Luzula arcuata* f. *confusa*, Danmarks Havn $^{12}/_{7}$ 08.

59. **Hendersonia gigantea** nov. spec.

Peritheciis immersis, saepe seriatim digestis, tectis, subglobosis, papillatis, brunneis, 225 μ diam., contextu parenchymatico; sporidiis cylindrico-fusoideis, flexuosis, laete flavo-brunneis, utrinque rotundatis, 92—108(—188) μ × 5—6 μ, 7-septatis, ad septa non constrictis, guttulatis (Look tab. X fig. 7).

Loc. On dead leaves of *Carex pulla*, Termometerfjeld $^{28}/_{7}$ 07.

Hyphomycetes.

60. **Trichothecium roseum** (Pers.) Link. Sacc. Syll. IV, p. 178.
Loc. On material vomited by owls, Termometerfjeld $^{22}/_{8}$ 07.

61. **Mastigosporium album** Riess. Sacc. Syll. IV, p. 220.
Loc. On living leaves of *Alopecurus alpinus*, Vester Elv $^{17}/_{7}$ 07.
Note. New for Greenland.

62. **Cladosporium graminum** Cda. Sacc. Syllog. IV, p. 365.
Loc. *Festuca ovina*, Termometerfjeld $^{28}/_{7}$ 07; *Hierochloa alpina*, Stormkap $^{19}/_{8}$ 06 and Hvalrosodde $^{16}/_{8}$ 07; *Glyceria angustata; Phippsia algida; Poa abbreviata*, Dove Bugt $^{3}/_{9}$ 07; *Poa glauca*, Danmarks Havn $^{14}/_{7}$ 08; *Trisetum spicatum*, Termometerfjeld $^{22}/_{8}$ 07.

63. **Cladosporium herbarum** (Pers.) Link. Sacc. Syllog. IV, p. 350.
Loc. On dead stems and fruits of *Cardamine bellidifolia*, Vester Elv $^{17}/_{7}$ 07; *Draba fladnizensis*, Termometerfjeld $^{27}/_{8}$ 07; *Draba hirta*, Danmarks Havn $^{26}/_{9}$ 07.

64. **Torula Rhododendri** Kze. Sacc. Syllog. IV, p. 254.
Loc. On twigs of *Rhododendron lapponicum*, Hvalrosodde $^{23}/_{8}$ 06.

Addendum.

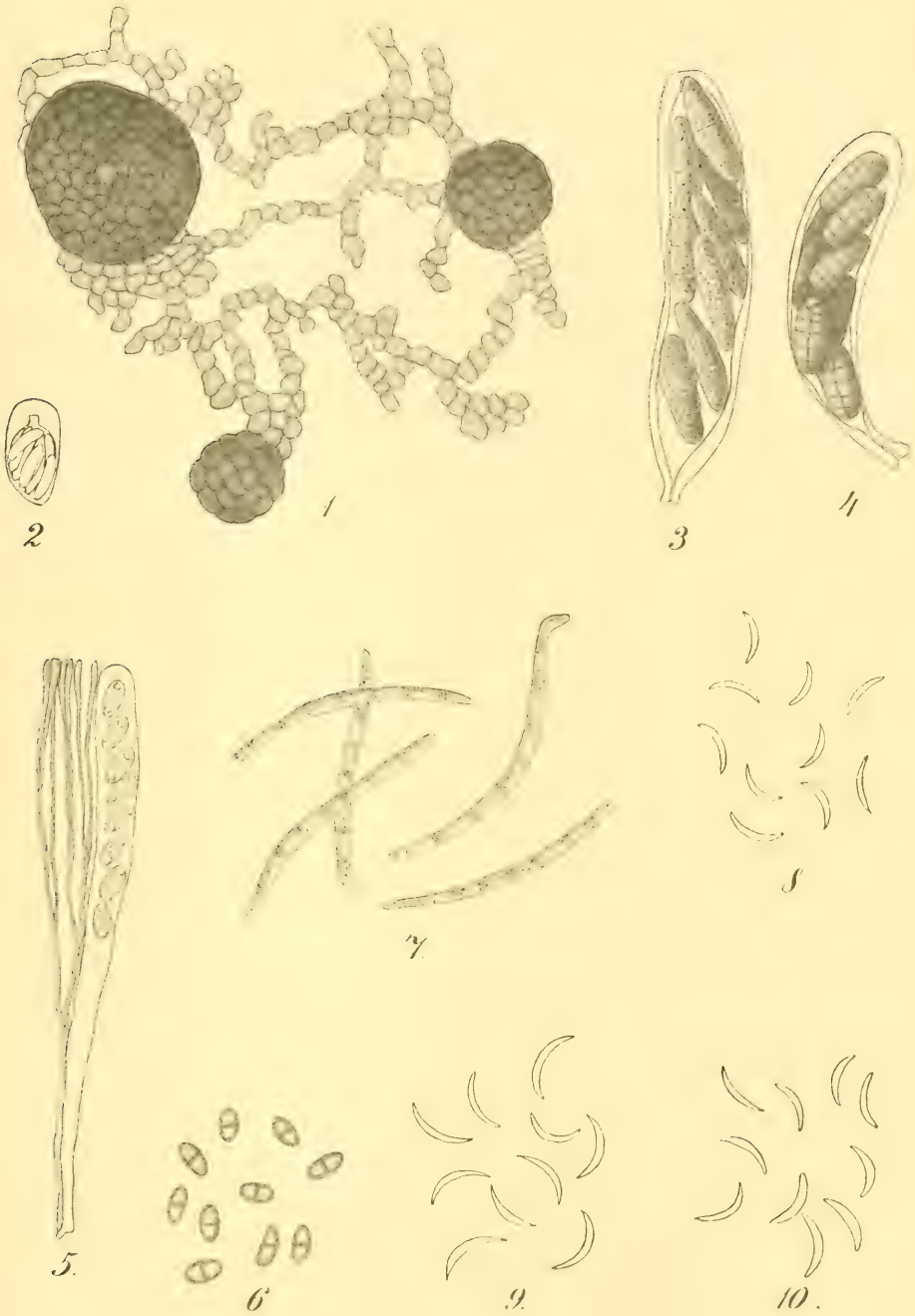
65. **Rhizophidium Olla** Henn. Petersen Contrib. à la connaiss. des Phycomycètes marins. Oversigt over d. k. Danske Vidensk. Selsk. Forh. 1905 p. 485.
Loc. Parasitic on Ectocarpus littoralis and Ulothrix scutata, East side of Koldewey Island (determ. Henn. E. Petersen).
Note. New for Greenland.

EXPLANATION OF THE FIGURES.

Fig. 1. Perithecia of Ascospora graminis spec. nov. on Poa glauca.
— 2. Ascus of — —
— 3. Ascus of Leptosphaeria caricinella Karst. on Carex pulla.
— 4. — of Pyrenophora filicina spec. nov. on Cystopteris fragilis.
— 5. — of Geopyxis ciborium (Vahl) Sacc.
— 6. Sporidia of Diplodia Simmonsii Rostrup on Luzula confusa.
— 7. — of Hendersonia gigantea spec. nov. on Carex pulla.
— 8. — of Rhabdospora Drabae (Fuck.) Berl. & Vogl. on Draba hirta var. arctica.
— 9. — of Rhabdospora groenlandica nom. nov. on Eutrema Edwardsii.
— 10. — of — — on Poa abbreviata.

All the figures have been drawn by Mr. Ove Rostrup. Fig. 1 is magnified 330 : 1, all the other are magnified 400 : 1.

1—6—1910.



O. Rostrup del.

VII.

HEPATICAE AND SPHAGNACEAE FROM NORTH-EAST GREENLAND

(N. OF 76° N. LAT.)

COLLECTED BY THE "DANMARK-EXPEDITION" 1906—08

DETERMINED

BY

C. JENSEN

1910

The mosses mentioned in this list have been collected by Mr. Andreas Lundager during the "Danmark Expedition" in the years 1907—1908. The collection is small and most of the specimens are only to be found sparsely mixed in tufts of other mosses. They have nearly all been taken from the neighbourhood in which the ship was ankered, on the north coast of Dove Bugt, about 76° 40′ N. Lat.

Hepaticae.

1. **Chomocarpon quadratus** (Scop.) Lindb.

Coast of Dove Bugt, on damp ground near a stream, ster. in a tuft of *Bryum ventricosum.*

2. **Odontoschisma Macounii** (Aust.) Underw.

"Stormkap" on the coast of Dove Bugt, ster. amongst *Sphaerocephalus turgidus, Dicranum congestum, Isopterygium nitidum,* and *Swartzia montana.*

3. **Cephalozia bicuspidata** (L.) Dum.

Coast of Dove Bugt, ster. amongst other mosses on damp ground near a stream.

4. **C. pleniceps** (Aust.) Lindb.

Coast of Dove Bugt, ster. in tufts of *Sphagnum fimbriatum* and *Dicranum neglectum* on damp ground near a stream.

5. **Cephaloziella divaricata** (Franc.) Schiffn.

Coast of Dove Bugt, ster. upon the ground or amongst and upon other mosses, such as *Dicranum neglectum, Conostomum boreale, Pohlia nutans, Swartzia montana, Ditrichum flexicaule, Blindia acuta* and several bog-mosses. The coast at 79° 8′, ster. in tufts of *Amphidium lapponicum.*

6. **C. striatula** (C. Jens.)

Coast of Dove Bugt, ster. on moist ground, amongst *Sphaerocephalus turgidus, S. palustris,* and *Calliergon sarmentosum.*

7. **Ptilidium ciliare** (L.) Hamp.

Coast of Dove Bugt, ster. amongst other mosses on damp ground near a stream.

8. **Anthelia julacea** (L.) Dum.)

Coast of Dove Bugt, ster. amongst bog-mosses on wet ground near a stream.

9. **A. nivalis** (Sw.) Lindb.

Coast of Dove Bugt, fr. on the ground near a stream.

10. **Blepharostoma trichophyllum** (L.) Dum.

Coast of Dove Bugt, ster. amongst other mosses on damp ground near a stream.

11. **Martinellia Bartlingii** (Nees.)

The coast at 79° 8′, ster. and gemmipar. amongst *Tortula ruralis, Swartzia montana* and a ster. *Bryum.*

12. **M. hyperborea** (Joerg.) Arn. et Jens.

Coast of Dove Bugt, ster. on wet ground near a stream.

13. **Jungermania quinquedentata** Huds.

Coast of Dove Bugt, ster. amongst *Dicranum neglectum* on moist ground.

Var. *turgida* Lindb.

From the same place, ster. amongst bog-mosses.

14. **J. alpestris** Schleich.

Coast of Dove Bugt, ster. amongst *Sphagnum fimbriatum* on damp ground near a stream.

15. **J. ventricosa** Dicks.

Coast of Dove Bugt, ster. in tufts of *Dicranum neglectum.*

16. **J. quadriloba** Lindb.

Coast of Dove Bugt, ster. amongst *Stereodon Bambergeri, Ditrichum flexicaule,* and *Myurella julacea* on damp ground.

17. **J. minuta** Cranz.

Coast of Dove Bugt, ster. in a tuft of *Dicranum elongatum.*

18. **Marsupella groenlandica** C. Jens.

Coast of Dove Bugt, ster. amongst other mosses such as *Calliergon sarmentosum, Sphaerocephalus turgidus, Oligotrichum glabratum* f. *gracilis, Ditrichum flexicaule, Swartzia montana, Cesia revoluta,* and *Anthelia julacea.*

19. **Cesia revoluta** (Nees.) Lindb.

Coast of Dove Bugt, ster. on damp ground near a stream, together with *Blindia acuta* and the preceding species.

20. **Riccardia pinguis** (L.) Gr.
Coast of Dove Bugt, ster. amongst bog-mosses near a stream.

Sphagnaceae.

21. **Sphagnum teres** Angstr.
Coast of Dove Bugt, ster. on moist ground near a stream.

22. **S. fimbriatum** Wils.
Coast of Dove Bugt, ster. from the same place as *S. teres*.

13—6—1910.

VIII.

MOSSES

FROM

NORTH-EAST GREENLAND

(N. OF 76° N. LAT.)

COLLECTED BY THE "DANMARK-EXPEDITION" 1906—1908

DETERMINED

BY

AUG. HESSELBO

1910

The Mosses brought home by the "Danmark Expedition" were for the most part collected by the botanist of the Expedition, Mr. ANDREAS LUNDAGER, in the neighbourhood of Danmarks Havn, on the east coast of Greenland, about 76° 46′ N. lat. A smaller number of collections has been made by Captain KOCH on his sledge-journeys northwards.

The species found in the following localities were collected by Captain KOCH; all the others have been collected by LUNDAGER.

Mallemukfjeld (June 11, 1907)	80° 10′ N. lat.
Lamberts Land (June 14, 1907)	79° 8′ —
Dove Bugt (June 28, 1907)	77° 30′ —
Bjørne Skærene (June 19, 1907)	77° —
North side of Hyde Fjord (May 15, 1907)	83° 10′ —

1. **Polytrichum juniperinum** Willd.

Vester Elv[1], sterile; sparingly intermingled in a tuft of *Dicranum elongatum.*

2. **Polytrichum strictum** Banks.

Vester Elv, several collections, one fruiting, mixed with other mosses (*Gymnocybe, Sphagnum* and *Meesea triquetra*).

3. **Polytrichum pilosum** Neck.

Vester Elv, a few plants in a tuft of *Schistidium apocarpum,* sterile. Termometer Fjeld, in a tuft of *Dicranoweissia compacta,* sterile.

4. **Polytrichum hyperboreum.**

Vester Elv, a few plants in a tuft of *Sphagnum, Gymnocybe palustris* and *Meesea triquetra.*

5. **Polytrichum fragile** Bryhn.

Cape Bismarck, a small sterile tuft mixed with sterile *Bryum.*

[1] The following is a translation of some of the suffixes used in the place-names which occur in this paper: Elv = stream; Fjeld = rock; Odde = head (tongue of land); Kær = pool; Skær = rock; Havn = harbour; Næs = ness (headland).

6. **Polytrichum alpinum** L.

Common; usually sterile and mixed with other mosses. Stormkap, fruiting.

var. **arcticum** (Sw.) Brid.

Vester Elv, fruiting.

var. **brevifolium** (R. Br.) Brid.

Lille Snenæs, fruiting.

7. **Polytrichum gracile** Dicks.

var. **anomalum** (Milde) Hagen.

This peculiar form which, according to HAGEN (Musci Norvegiae borealis, p. 265) and to verbal information from C. JENSEN, is commonly distributed in northern Scandinavia, was found by Vester Elv intermingled in tufts of swamp-mosses such as *Amblystegium revolvens, A. sarmentosum, Bryum neodamense,* var. *ovatum,* etc.

The plants are as much as 8 cm. high, flaccid, with nearly entire leaves (forma *subintegrifolia*), but otherwise exactly resembling Norwegian specimens.

Polytrichum gracile has not previously been found in Greenland, and its northern limit as hitherto known is at about 70° N. lat. in Finmark.

8. **Oligotrichum laevigatum** Wahlb.

Vester Elv, sparingly intermingled in a tuft of *Hepaticae, Ditrichum flexicaule,* and other mosses (forma *tenuis brevifolia*).

9. **Cinclidium arcticum** (Br. eur.) C. M.

Vester Elv, sterile; a few plants in a tuft of *Gymnocybe turgida, Meesea triquetra* and *Sphagnum.*

10. **Cinclidium polare** Bryhn.

North side of Hyde Fjord among other mosses; sterile (KOCH).

11. **Astrophyllum curvatulum** Lindb.

Vester Elv, sparingly among *Gymnocybe turgida, Meesea triquetra,* and other mosses. Maroussia Island, a few plants in a tuft of *Bryum pendulum;* in both places forma *integrifolia.*

12. **Astrophyllum orthorhynchum** (Brid.) Lindb.

Vester Elv, a few sterile plants in a tuft of *Stereodon Bambergeri* and *Ditrichum flexicaule.* Lamberts Land, sterile (Koch).

13. **Timmia austriaca** Hedw.

Lamberts Land, sterile (forma *brevifolia*).

var. **papillosa** v. n.

The sheath-like part of the leaf papillose at the point of transition to the lamina. The leaf-margin coarsely denticulate at the apex and indistinctly denticulate downwards.

Stormkap, mixed with *Gymnocybe turgida*, *Pohlia cruda* and *Stereodon revolutus*.

14. **Timmia bavarica** Hessl.

Vester Elv, sterile, among *Amblystegium revolvens*, *A. latifolium* and *Meesea triquetra*.

15. **Timmia norvegica** Zett.

var. **crassiretis** v. n.

The cells of the leaf incrassated especially upon the lower side where the outer walls are also mamillosely convex. The cells of the leaf-base papillose almost to the base.

North side of Hyde Fjord; sparingly among *Hypna*, *Brya*, *Cinclidium polare*, etc.

16. **Gymnocybe palustris** (L.) Friis.

Vester Elv, sterile. Hare Fjeld, sterile. Dove Bugt, sterile.

17. **Gymnocybe turgidus** (Wahlb.) Lindb.

One of the most common mosses; occurs as a component of most of the tufts which were collected, rarely unmixed, always sterile.

18. **Meesea triquetra** (L.) Aongst.

Found as a component of a large number of the tufts collected from all the localities, generally mixed with *Amblystegium sarmentosum*, *A. revolvens*, *A. intermedium* and *A. latifolium*. It occurs sometimes with entire, and sometimes with serrulate leaves.

19. **Meesea longiseta** Hedw.

Vester Elv, sterile, a few plants in a tuft of *Meesea triquetra*, *Timmia bavarica* and *Hypna*.

20. **Philonotis alpicola** Jur.

Common as a component of mixed tufts, but always scanty and sterile.

21. **Philonotis fontana** (L.) Brid.

var. **adpressa** (Fergusson).

Cape Bismarck, sterile. Vester Elv, sterile.

22. **Bartramin ityphylla** Brid.

Hare Fjeld, fruiting. Danmarks Havn, fruiting. Vester Elv, several sterile specimens among other mosses.

23. **Conostomum tetragonum** (Will.) Sw.

Vester Elv, sterile, several collections, partly unmixed and partly mixed with other mosses.

24. **Bryum elegans** Nees.
Basis Kær, intermingled in a tuft of *Tetraplodon Wormskjoldii.*

25. **Bryum ventricosum** Dicks.
Vester Elv ♀. Hvalros Odde ♀. North side of Hyde Fjord, sterile (forma *tenuis brevifolia*).

26. **Bryum neodamense** Itzigs.
var. **ovatum** Jur.
Vester Elv, sterile, many specimens, but usually sparingly among other mosses.

27. **Bryum teres** Lindb.
Vester Elv, sterile. Havne Næs, sterile.

28. **Bryum cirratum** Hornsch.?
Stormkap, with ♀, ♂ and ☿ inflorescence, but without fruit.

29. **Bryum obtusifolium** Lindb.
Hare Fjeld, sterile. Termometer Fjeld, sterile. Sometimes umixed, sometimes mixed with *Amblystegium sarmentosum*, *Pohlia commutata* and other species.

30. **Bryum cyclophyllum** (Schwgr.). Br. eur. Termometer Fjeld, sterile.

31. **Bryum tomentosum** Limpr.
Hare Fjeld, fruiting.

32. **Bryum foveolatum** Hagen.
Hvalros Odde; fruiting.

33. **Bryum pendulum** (Hornsch.) Schimp.
Vester Elv, fruiting. Maroussia Island, fruiting.

34. **Bryum calophyllum** R. Br.
At Danmarks Havn on damp sandy soil, sterile.

35. **Bryum argenteum** L.
Lille Snenæs, sterile. Renskæret, sterile. Maroussia Island, sterile. Danmarks Havn, sterile (forma *compacta brevifolia*).

36. **Bryum Myliusii** n. sp.
About three cm. high, loose tufts among other mosses. Stem red, 0·30 mm. thick, slightly radiculose, with slender, papillose rhizoids, and bearing one or two young shoots below the inflorescence. Leaves firm, narrowly-decurrent, entire, hollow, bordered by 2—4 rows of narrow, brownish cells. Stem-leaves broadly-ovato, 1·2—1·5 mm. long and about 1 mm. broad and bluntly, or shortly and broadly pointed, revolute at the base; upper leaves broadly lanceolate,

2—2·2 mm. long and 1—1·2 mm. broad, shortly and broadly pointed, revolute at the margins until towards the apex. Veins strong, brown, 0·10 mm. broad at the base and disappearing close under the apex. Leaf-cells brownish, incrassate, porose, rectangular at the base, 0·020—0·028 mm. broad and 2—3 times as long, in the rest of the leaf hexagonal and rhombic, 0·018—0·20 broad, and about twice as long.

Synoicous. Perichaetial-leaves broadly-lanceolate, pointed, indistinctly marginate. Antheridia and archegonia numerous.

Seta red, about 2 cm. high and 0·18 mm. thick. Capsule pendulous, in dry condition leather-brown and slightly wrinkled, not constricted below the mouth, about 1·5 mm. thick and 2·5—3 mm. long, of which the neck constitutes one half. The cells of the capsule-walls irregular, slightly incrassate; 2—4 rows of small, roundish or polygonal cells around the mouth.

Peristome teeth, 0·36 mm. long, and 0·10 mm. broad at the base, yellow, darker at the base, hyaline and indistinctly marginate at the apex. Lamellæ 15 in number, occasionally connected by a transverse trabecula. The median line slightly sinuous. Dorsal plates narrowly rectangular at the base, 2—3 times as broad as high, extremely delicately striped with papillæ, smooth towards the apex. Inner peristome probably not attached, pale, finely papillose. Cilia rudimentary. Spores 0·028—0·036 mm., brownish-yellow, finely papillose.

Vester Elv, associated with *Amblystegium revolvens*, *A. latifolium*, *A. sarmentosum* and *Meesea triquetra*.

37. **Pohlia commutata** (Schimp.) Lindb.

Vester Elv; Hare Fjeld; Stormkap. It usually occurs sparingly intermingled with other mosses. Found sterile only.

var. **filum** (Schimp.) Husnot.

Termometer Fjeld; partly in large, unmixed tufts, and partly mixed with *Bryum obtusifolium*.

38. **Pohlia cruda** (L.) Lindb.

Vester Elv, several specimens, one fruiting, in part var. *minus* Sch. Havne Næs, sterile. Termometer Fjeld, sterile. Lamberts Land, fruiting.

39. **Pohlia nutans** (Schreb.) Lindb.

Vester Elv, numerous specimens, of which several fruiting, often mixed with other mosses. Hvalros Odde; sterile. Lille Snenæs, sterile. Dove Bugt, sterile.

40. **Leptobryum pyriforme** (L.) Wills.

Lille Snenæs, fruiting. Maroussia Island, fruiting.

41. **Tetraplodon Wormskjoldii** (Hornem.) Lindb.
Hare Fjeld, fruiting, large cushions about 10 cm. high upon the skull of a musk-ox.

42. **Tetraplodon pallidus** Hagen.
Stormkap, mixed with *Gymnocybe turgidus* and other mosses, fruiting.

43. **Leersia rhabdocarpa** (Schwägr.) Lindb.
Havne Næs, sterile, in a dry ravine. Vester Elv, fruiting, in both places mixed with *Tortula latifolia* and *Bryum argenteum*. Hvalros Odde, sterile.

44. **Tortula ruralis** (L.) Ehrt.
Vester Elv; Basis Kær; Termometer Fjeld; Lamberts Land; sparingly in all the localities and sterile, among other mosses.

45. **Tortula norvegica** (Wlb. f.) Wahlenb.
Clayey field between Laxe Sø and Øster Sø, sterile.

46. **Tortula mucronifolia** Schwägr.
Havne Næs, in a dry ravine, fruiting.

47. **Tortula systylia** (Br. eur.) Lindb.
Havne Næs, in a dry ravine, fruiting.

48. **Tortula latifolia** (Hedw.) Lindb.
Vester Elv, fruiting. Havne Næs, in a dry ravine, fruiting.

49. **Mollia fragilis** (Drumm.) Lindb.
Bjørne Skærene, sterile, in a compact tuft of *Carex*. (Koch).

50. **Barbula rubella** (Hoffm.) Mitten.
var. **brevifolia** Arnell et Lindb.
Vester Elv, sterile.

51. **Barbula alpigenia** (v. Venturi.)
Vester Elv, sterile, a few plants intermingled in a tuft of *Ditrichum flexicaule*, *Gymnocybe turgidus* and other mosses.

52. **Barbula curvirostris** (Ehrh.) Lindb.
North side of Hyde Fjord, sterile, sparingly among *Hypna*, *Cinclidium polare* and other mosses (forma *brevifolia*).

53. **Dicranum congestum** Brid.
Basis Kær, sterile, partly unmixed, partly mixed with other mosses.

54. **Dicranum neglectum** Jur.
Vester Elv, sterile. Stormkap, sterile.

55. **Dicranum elongatum** Schleich.
Vester Elv, sterile.

56. **Blindia acuta** (Huds.) Br. eur.
Vester Elv, sterile, both unmixed and mixed with other mosses. Basis Kær, sterile.

57. **Dicranoweissia crispula** (Hedw.) Lindb.
Termometer Fjeld, sterile.

58. **Dicranoweissia compacta** (Schleich.) Sch.
Termometer Fjeld, sterile.

59. **Swartzia montana** (Lam.) Lindb.
Vester Elv, sterile. Lille Snenæs, sterile. Stormkap, sterile. Hvalros Odde, sterile. Termometer Fjeld, fruiting. Bjørne Skærene, sterile. Everywhere forma *brevifolia.*

60. **Ditrichum flexicaule** (Schleich.) Hampe.
Common, but usually in small quantities in the collections from all the localities. Usually forma *brevifolia.*

61. **Ceratodon purpureus** (L.) Brid.
Cape Bismark, sterile. Vester Elv, sterile. Termometer Fjeld, sterile. Mallemukfjeld, sterile.

62. **Dorcadion Kiliassii** (C. M.) Lindb.
On stones at Danmarks Havn, fruiting. Basis Kær, sterile.

63. **Anoectongium lapponicum** Hedw.
Lamberts Land.

64. **Grimmia ericoides** (Schrad.) Lindb.
Vester Elv, sterile (partly var. *strictum* Schliep.). Lamberts Land (var. *prolixum* Br. eur.)

65. **Grimmia hypnoides** (L.) Lindb.
Termometer Fjeld, sterile, Lamberts Land, sterile.

66. **Grimmia Donniana** Smith.
Termometer Fjeld, sterile, associated with *Dicranoweissia compacta.*

67. **Grimmia apocarpa** (L.) Hedw.
One of the mosses of most common occurrence. Numerous specimens have been collected from all the localities which have been investigated: on stones, rocks and earth. Usually fruiting. It varies considerably both in habit, colour, leaf-form and length of hair-tip. The most peculiar forms are: —
var. **filiformis** Lind. Syn. Grimmia tenera Zett.; Termometer Fjeld, fruiting. Vester Elv, sterile.
var. **ovatum** Bryhn.
Frequent. Usually fruiting.

68. **Grimmia linearis** (Chalubinsky).
Syn. Schistidium angustum Hagen.
Vester Elv, fruiting, mixed with *Grimmia apocarpa* var. *ovatum*.

69. **Amblystegium radicale** (P. B.) Mitten.
var. **pulcherrimum** n. v.
Tufts compact, 1—2 cm. high, rusty brown below, green at the top. Stem short and irregularly branching, 0·10 mm. thick, with a few rhizoids. Leaves 0·5—0·8 mm. long, 0·14—0·18 mm. broad, finely serrate along the whole margin; sterile.
Mallemukfjeld (Koch).
Amblystegium radicale has not previously been found in Greenland.

70. **Amblystegium protensum** (Brid.) Lindb.
Maroussia Island. Sparingly in a tuft of *Bryum pendulum*; sterile.

71. **Amblystegium stellatum** (Schreb.) Lindb.
Hare Fjeld, sterile, among other mosses.

72. **Amblystegium latifolium** Lindb.
Very common and collected partly as unmixed cushions and partly among other mosses from all the localities which were investigated.

73. **Amblystegium brevifolium** Lindb.
Vester Elv, sterile. North side of Hyde Fjord, sterile. In both places sparingly among other mosses.

74. **Amblystegium intermedium** Lindb.
Vester Elv, sterile. Stormkap, sterile. North side of Hyde Fjord, sterile.

75. **Amblystegium revolvens.**
Vester Elv, sterile. Stormkap, sterile.

76. **Amblystegium aduncun** (L.) Lindb.
Vester Elv, sterile. Termometer Fjeld, sterile. In both places sparingly among other mosses.
var. **gracillimum** Bergg.
Termometer Fjeld, sterile.

77. **Amblystegium exannulatum** (Gumb.) de Not.
Vester Elv, sterile.

78. **Amblystegium fluitans** (L.) de Not.
Edge of Laxe Sø, sterile.

79. **Amblystegium purpurascens** (Schimp.)
Vester Elv, sterile.

80. **Amblystegium polare** (Lindb.) Lindb.

Vester. Elv, ♀, partly in unmixed cushions, partly mixed with other *Hypnaceae*.

var. **pseudostramineum** Lindb.

Typical specimens of this peculiar form were collected at Termometer Fjeld in rather compact tufts about 6 cm. high, with erect, almost branchless, round stems, and shortly-pointed very concave leaves which only towards the apex of the stem are indistinctly secundly bent. At the same place, at the edge of the inland ice, a form was found which, both in regard to habit and leaf-form, stands between the type and the variety. The variety was previously known only from Spitzbergen.

81. **Amblystegium turgescens** (Th. Jurs.) Lindb.

Vester Elv, sterile. Lille Snenæs, sterile. In both places sparingly among other mosses.

82. **Amblystegium sarmentosum** (Wahlenb.)

Is the most commonly occurring species. Was collected abundantly in unmixed tufts, and also occurred as a component of most of the moss-collections which were made.

83. **Amblystegium Richardsonii** (Mitten) Lindb.

North side of Hyde Fjord, sterile, a few plants among other swamp-mosses.

84. **Hypnum plumosum** Huds.

Dove Bugt, sterile. Maroussia Island, sterile. Bjørne Skærene, sterile.

85. **Myurella tenerrima** (Brid.) Lindb.

Vester Elv, in a tuft of *Polytrichum pilosom*. Stormkap, sterile. Lamberts Land, sterile, among *Swartzia*, *Ditrichum flexicaule* and *Gymnocybe*.

86. **Myurella julacea** (Vill.) Br. eur.

Stormkap, sterile. Lille Snenæs, sterile. Vester Elv, sterile. Bjørne Skærene, sterile. Everywhere mixed with other mosses in tufts.

87. **Hylocomium proliferum** (L.) Lindb.

var. **Alaskanum** (Lesq. et James).

Vester Elv, a single plant in a tuft of *Sphaerocephalus palustris* and *Sphagnum*.

88. **Stereodon revolutus** Mitten.

Vester Elv, sterile. Stormkap, sterile. Lille Snenæs, sterile. Basis Kær, sterile. North side of Hyde Fjord, sterile. Everywhere mixed with other mosses.

89. **Stereodon Bambergeri** (Sch.) Lindb.)

Vester Elv, sterile. North side of Hyde Fjord, sterile. In both places among other mosses.

90. **Stereodon chryseus** (Schwgr.) Mitten.

Vester Elv, sterile, several collections, in part among other mosses. Hvalros Odde, sterile. North side of Hyde Fjord, sterile, sparingly among other mosses.

91. **Isopterygium nitidum** (Wahlb.) Lindb.

Vester Elv, sterile. Maroussia Island, sterile. Stormkap, fruiting. Bjørne Skærene, sterile. Everywhere sparingly among other mosses.

PLATE XI.

Fig. 1. Polytrichum gracile var. anomalum. Habit $^{1}/_{1}$.
— 2—3. — — — Leaves $^{12}/_{1}$.
— 4. — — From the middle portion of a leaf $^{115}/_{1}$.
— 5. Bryum Myliusii. 2 capsules $^{4}/_{1}$.
— 6. — — Habit $^{2}/_{3}$.
— 7—8. — — Leaves $^{25}/_{1}$.

PLATE XII.

Fig. 9. Amblystegium polare var. pseudostramineum. Habit $^{1}/_{1}$.
— 10. — — — Leaf $^{40}/_{1}$.
— 11. — — — Leaf-base $^{100}/_{1}$.
— 12. Amblystegium radicale var. pulcherrimum. Habit $^{3}/_{1}$.
— 13. — — — Leaf $^{125}/_{1}$.

14—7—1910.

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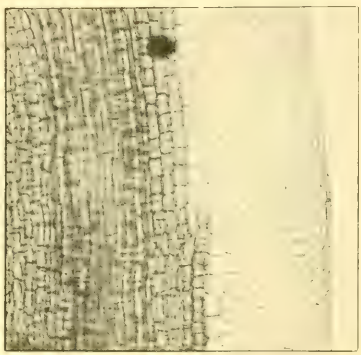

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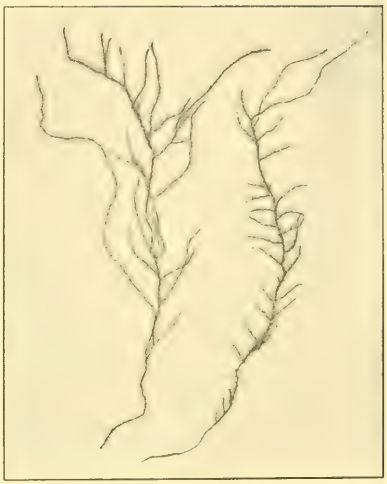

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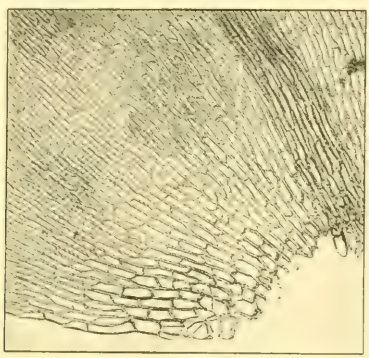

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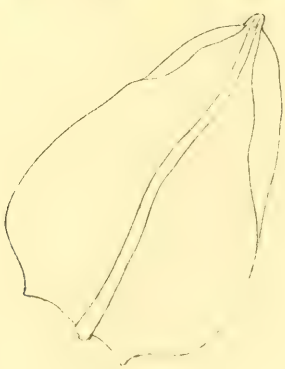

10

IX.

LICHENS

FROM

NORTH-EAST GREENLAND

(N. OF 76° N. LAT.)

COLLECTED BY THE "DANMARK-EXPEDITION" 1906—1908

DETERMINED

BY

OLAF GALLØE

1910

The work of the "Danmark-Expedition" has brought to a preliminary close the purely floristic side of lichen collecting in Greenland, as practically the whole coast of the land has now been investigated. Later collections will assuredly be able to find one thing or another new, but we already have a view over the floristic character of the lichen vegetation, thanks to the persevering scientists who in the course of time have added to the collections in the Botanical Museum of Copenhagen.

What has been known hitherto of the Greenland lichens is to be found mainly in the papers by Deichmann Branth and Grønlund in the "Meddelelser om Grønland", Hefte III (1888) and the Appendix (ibidem 1892), as also in later papers by Branth and by Wainio (ibidem Hefte XVIII and XXX).

Our floristic knowledge now extends so far, that it will undoubtedly be of greatest interest to begin a biological and ecological investigation of these plants, not only for the arctic species but also for the species of the whole world. Far too little attention has hitherto been paid to the part played by the lichens in the existing plant-associations and to the mutual relations between the lichens and the widely different natural conditions offered them at their varied and different places of growth.

The species mentioned here have almost all been found in Greenland before. A single species is however remarkable, as it has hitherto not been found in that country, or at least is not present in the collections of our Museum, namely *Dufourea muricata*, which was found for the first time in arctic regions by Th. Fries in Spitzbergen.

A discussion of the correctness of the more difficult species has been omitted, as it would lead as too far here — even though the subject might in itself be tempting for several Parmelia species and a few others.

Under each species reference is made to a main work, where further information on the literature can be obtained.

The following is the principal literature:

1. J. S. DEICHMANN BRANTH og CHR. GRØNLUND: Grønlands Lichen-Flora. Meddelelser om Grønland. Hefte III. Kjøbenhavn 1888.
2. J. S. DEICHMANN BRANTH: Tillæg til Grønlands Lichen-Flora (ibid. 1892).
3. J. S. DEICHMANN BRANTH: Lichener fra Scoresby Sund og Hold with Hope. (ibid. XVIII. 1896).
4. DUC d' ORLÉANS: Croisière océanographique . . . . dans la mer du Groenland. Botanique. Bruxelles 1908. (Here in: Lichens, déterminés par J. S. Deichmann Branth).
5. FRIES, TH.: Lichenes Arctoi etc. Upsaliæ 1860.
6. FRIES, TH.: Lichenes Scandinavici vol. I. Upsaliæ 1871—74.
7. FRIES, TH.: Lichenes Spitsbergenses (Kongl. Svenska Vet.-Akad. Handl. Bd. VII Nr. 2. Stockholm 1867).
8. C. H. OSTENFELD og ANDR. LUNDAGER: List of vascular plants from north-east Greenland etc. (Meddelelser om Grønland XLIII. Kjøbenhavn 1910).
9. EDW. WAINIO: Lichenes expeditionis G. AMDRUP (Medd. om Grønl. XXX. 1905).

The material for the present list was collected by Mr. ANDREAS LUNDAGER.

With regard to the position of the places where the various species were taken I may refer to the above-cited work of OSTENFELD and LUNDAGER.. They lie mainly about Danmarks Havn, 76° 46′ n. L.

SYSTEMATIC LIST OF THE LICHENS.

Usnea Dill.

1. **Usnea melaxantha** Ach. Th. Fries, Lich. arct. p. 24. — Branth og Grønl.: Grønl.s Lichen-Flora, p. 464.

Loc.: Cape Bismarck, Danmarks Havn.

Common among stones, where it grows abundantly; found also on hilly ground, on stones.

Bryopogon Link.

2. **Bryopogon jubatus** L. *β. nitidulum* Th. Fr. Th. Fries: Lich. arct. p. 25. — Branth og Grønlund: Grønlands Lichen-Flora p. 464.

Loc.: Termometerfjeld (among moss, on the ground); Danmarks Havn (on the ground).

Alectoria Ach.

3. **Alectoria Thulensis** Th. Fr. Th. Fr. Lich. arct. p. 28. — Branth og Grønlund: Grønlands Lichen-Flora p. 465.

Loc.: Termometerfjeld (on the ground, among moss); at the Danmarks Havn (on ground about the moss); common.

Cornicularia Ach.

4. **Cornicularia aculeata** (Ehrh.). Th. Fries: Lich. arct. p. 30. — Branth og Grønlund p. 465.

Loc.: Termometerfjeld (on sandy ground).

Cetraria Ach.

5. **Cetraria islandica** L. Th. Fries: Lich. arct. p. 35. — Branth og Grønlund p. 466. — All the specimens found belong to var. *Delisei* Bory.

Loc.: Termometerfjeld (on the ground, among moss).

6. **Cetraria odontella** Ach. Th. Fries: Lich. arct. p. 36. — Branth og Grønlund p. 466.

Loc.: Termometerfjeld (on the ground), Danmarks Havn (on the ground), the Bay (on the ground, among moss), Snenæs (on the ground), Storm Kap (among moss).

7. **Cetraria nivalis** L. Th. Fries: Lich. arct. p. 37. — Branth og Grønlund p. 466.

Loc.: Termometerfjeld (very common on sandy ground), Danmarks Havn (among moss on the ground), the Bay (on the ground), Snenæs (on the ground).

8. **Cetraria Fahlunensis** (L.) Schær. Th. Fries: Lich. scandinavici p. 108. — Branth og Grønlund p. 471.

Loc.: Danmarks Havn (among moss).

Nephroma Ach.

9. **Nephroma papyraceum** Hoffm. Lich. arct. p. 42. — Branth og Grønlund p. 467.

Loc.: Termometerfjeld (on mosscovered ground).

Peltigera Hoffm.

10. **Peltigera rufescens** Fr. Lich. arct. p. 45. — Branth og Grønlund p. 468.

Loc.: Hvalrosodde (on a withered tuft), Basiskær (on mossy ground), Danmarks Havn (damp soil above moss).

Peltidea (Ach.) Nyl.

11. **Peltidea aphtosa** L. Lich. arct. p. 43. — Branth og Grønlund p. 468.

The locality is not exactly indicated in the material collected. — On a dead Empetrum tuft.

Solorina Ach.

12. **Solorina crocea** L. Lich. arct. p. 48. — Branth og Grønlund p. 469.

Loc.: Termometerfjeld (on the ground), Danmarks Havn (on clay ground).

Parmelia Ach.

13. **Parmelia saxatilis** L. Lich. arct. p. 52. — Branth og Grønlund p. 469.

Loc.: Termometerfjeld (on stones); only the variety *omphalodes* L. was found.

14. **Parmelia encausta** Sm. Lich. arct. p. 54. — Branth og Grønlund p. 470.

Loc.: Occurs very frequently with the variety *intestiniformis* Vill., for example at Termometerfjeld, at Danmarks Havn and at Basiskær, everywhere on stones.

15. **Parmelia stygia** L. Lich. arct. p. 57. — Branth og Grønlund p. 470.

Loc.: Varde Ridge (on stones).

16. **Parmelia alpicola** Th. Fr. Lich. arct. 57. — Branth og Grønlund p. 470.

Loc.: Danmarks Havn (on stones).

17. **Parmelia lanata** L. Lich. arct. p. 58. — Branth og Grønlund p. 470.

Loc.: North Koldewey Island (on stones), Termometerfjeld (on stones), Danmarks Havn (on stones), Basiskær (common on stones).

Physcia Fr.

18. **Physcia pulverulenta** Schreb. Lich. arct. p. 63. — Branth og Grønlund p. 472.

Loc.: Termometerfjeld, Basiskær, Danmarks Havn, the Bay, Snenæs, at all places above moss on the ground. All the specimens belonged to the variety *muscigena* Ach.

19. **Physcia stellaris** L. Lich. arct. 63. — Branth og Grønlund p. 472.

Loc.: Danmarks Havn (on ground among moss), Termometerfjeld (on stones), a single specimen on a decayed reindeer horn.

Xanthoria Fr.

20. **Xanthoria elegans** Link. Lich. arct. p. 69. — Branth og Grønlund p. 473.

Loc.: very common, e. g. Hvalrosodde (on stones), Termometerfjeld (on stones), Danmarks Havn (ground and small stones), the Bay (on ground), Lille Snenæs (on bone).

21. **Xanthoria lychnea** (Ach.) Th. Fr. Th. Fries: Lich. scandinav. p. 146.

Loc.: Termometerfjeld (on ground), the Bay (on ground), (some specimens on a decayed reindeer horn).

Placodium Hill.

22. **Placodium fulgens** (Sw.) Lich. arct. p. 81. — Branth og Grønlund p. 475.

Loc.: Danmarks Havn (on ground), Lille Snenæs (on ground). All the specimens belong to the variety *alpinum* Th. Fr.

Acarospora Mass.

23. **Acarospora smaragdula** Wnbg. Lich. arct. p. 92. — Branth og Grønlund p. 477.

Loc.: Termometerfjeld (on stones).

Lecanora Ach.

24. **Lecanora tartarea** L. Lich. arct. p. 99. — Branth og Grønlund 478.

Loc.: Termometerfjeld (moss-covered ground), Danmarks Havn (above moss on the ground).

25. **Lecanora Hageni** Ach. Lich. arct. p. 106. — Branth og Grønlund p. 479.

Loc.: Basiskær (on dead moss on the ground), Danmarks Havn (on dead Dryas), the Bay (on ground), Hvalrosodde (on decayed whale-bones), Snenæs (on decayed whale-bones), further some specimens on an old reindeer horn.

26. **Lecanora polytropa** Ehr. Lich. arct. p. 110. — Branth og Grønlund p. 481.

Loc.: Danmarks Havn (on stones); all the specimens belonged to the variety *conglobata* (Smrft).

27. **Lecanora cenisea** Ach. Lich. arct. p. 115. — Branth og Grønlund p. 480.

Loc.: Lille Snenæs (on the hill, most abundant on the north side), Danmarks Havn (on stones).

28. **Lecanora bryontha** Ach. Lich. arct. p. 117. — Branth og Grønlund p. 481.

Loc.: Termometerfjeld (on the ground).

Caloplaca Th. Fr.

29. **Caloplaca cerina** (Ehrh.) Th. Fr. Th. Fr. Lich. scand. p. 173. — Branth og Grønlund p. 482.

Some few specimens on a decayed reindeer horn.

30. **Caloplaca pyracea** (Ach.) Th. Fr. Lich. scand. p. 178. — Branth og Grønlund p. 482.

Loc.: Lille Snenæs (on decayed bone), as also several places on reindeer horn and on raw humus ground among moss.

31. **Caloplaca Jungermanniæ** (Vahl) Th. Fr. Lich. scand. p. 180. — Branth og Grønlund p. 482.

Loc.: Basiskær (on ground over dead moss), Danmarks Havn (on ground), the Bay (on dead moss), as also at one place on reindeer horn. — All the specimens belonged to the variety *subolivacea* Th. Fr.

32. **Caloplaca ferruginea** (Huds.) Th. Fr. Lich. scand. p. 184. — Branth og Grønlund p. 482.

Loc.: Several places not exactly indicated, on stones (and moss). All the specimens belonged to the variety *nigricans* Tuckerm.

33. **Caloplaca vitellina** (Ehrh.) Th. Fr. Lich. scand. p. 188.

On decayed reindeer horn (well-developed, with apothecia), also several places as a rule sterile (and thus easily mistaken).

34. **Caloplaca subsimilis** Th. Fr. Lich. scand. p. 189.

Loc.: Termometerfjeld (among moss on the ground), Lille Snenæs (on whale bone), as also sterile at several places.

Rinodina Mass.

35. **Rinodina turfacea** Wnbg. Lich. arct. p. 126. — Branth og Grønlund p. 483.

Loc.: Termometerfjeld (on moss).

36. **Rinodina mniaroea** Ach. Lich. arct. p. 127. — Branth og Grønlund p. 483.

Loc.: Termometerfjeld (on ground), Danmarks Havn (clay soil) — All the specimens belonged to the variety *cinnamomea* Th. Fr.

37. **Rinodina exigua** Ach. Lich. arct. p. 129. — Branth og Grønlund p. 483.

At several places (on wood) not exactly indicated.

Aspicilia Mass.

38. **Aspicilia calcarea** L. Lich. arct. p. 130. — Branth og Grønlund p. 484.

Loc.: not exactly given; on sand-stone. The specimen belongs to the variety *contorta* Hoffm.

Stereocaulon Schreb.

39. **Stereocaulon coralloides** Fr. Lich. arct. p. 142. — Branth og Grønlund p. 486.

Loc.: Varde Ridge (on ground), the Bay (on ground). All the specimens belonged to the variety *conglomeratum* Fr.

40. **Stereocaulon evolutum** Græwe. Lich. scand. p. 45.

Loc.: Varde Ridge (on ground), Danmarks Havn (on ground).

41. **Stereocaulon paschale** L. Lich. arct. p. 143. — Branth og Grønlund p. 485.

Loc.: Seems to be very common, e. g. Dove Bugt (on loose sand), Danmarks Havn (among moss), Cape Bismarck (on ground among moss), Varde Ridge (both on dry and damp ground, among moss), the Bay (among moss), Basiskær (on damp ground).

Cladonia Hoffm.

42. **Cladonia coccifera** (L.) Willd. Wainio: Monographia Clad. I p. 149. — Branth og Grønlund p. 488, Cl. carnucopioides.

Loc.: Renskæret (on mossy ground).

43. **Cladonia decorticata** (Floerke) Spreng. Wainio, Monogr. Clad. II p. 67.

Loc. Renskæret (on ground).

44. **Cladonia degenerans** (Floerke) Spreng. Wainio, Monogr. Clad. II p. 135. — Branth og Grønlund p. 487.

Loc.: Not exactly given; on ground.

45. **Cladonia pyxidata** (L) Fr. Wainio: Monogr. Clad. II p. 209. — Branth og Grønlund p. 487.

Loc.: Basiskær (on dry ground), Termometerfjeld (on sandy ground), Varde Ridge (on ground, in part over moss).

46. **Cladonia fimbriata** (L) Fr. Wainio: Monogr. Clad. II p. 246. — Branth og Grønlund p. 487.

Loc.: Danmarks Havn (on dry ground).

47. **Cladonia foliacea** (Huds.) Schaer. v. *alcicornis* (Lightf.) Schær. Wainio: Monogr. Clad. II p. 384. — Branth og Grønlund p. 484, Clad. *alcicornis*.

Loc.: Danmarks Havn (on dry ground, in part over moss; fairly common).

Note. In addition to the species mentioned here, there are also several very little developed specimens mong the other lichen samples; they cannot be determined in their present state.

Thamnolia Ach,

48. **Thamnolia vermicularis** Sw. Lich. arct. p. 161 — Branth og Grønlund p. 465.

Loc.: Hvalrosodde (among moss on the ground), Termometerfjeld (among moss on the ground), Danmarks Havn (on the ground).

Dufourea Ach.

49. **Dufourea muricata** Laur. Th. Fries: Lich. Spitsbergenses p. 10, in Kongl. Svenska Vetenskaps-Akad. handl. Bd. 7, Nr. 2. Stockholm 1867.

Loc.: Snenæs (on the ground).

Gyrophora Ach.

50. **Gyrophora hyperborea** Ach. Lich. arct. p. 164. — Branth og Grønlund p. 490.

Loc.: Termometerfjeld (on stones).

51. **Gyrophora erosa** Web. Lich. arct. p. 164. — Branth og Grønlund p. 490.

Loc.: Danmarks Havn (on stones), Renskæret (on stones).

52. **Gyrophora proboscidea** L. Lich. arct. p. 166. — Branth og Grønlund p. 490.

Loc.: Termometerfjeld (on stones), Danmarks Havn (on stones), Varde Ridge (on stones); seems to be common in North-East Greenland.

53. **Gyrophora cylindrica** L. Lich. arct. p. 166. — Branth og Grønlund p. 491.

Loc.: Termometerfjeld (on stones), Pustervig (on stones), Basiskær (on stones), Danmarks Havn (on stones), Varde Ridge (on stones, 200 m. above the sea).

Lopadium Koerb.

54. **Lopadium pezizoideum** Ach. Lich. arct. p. 201. — Branth og Grønlund p. 497.

Loc.: Termometerfjeld (on the ground).

Arthrorhaphis Mass.

55. **Arthrorhaphis flavo-virescens** Dicks. Lich. arct. p. 203. — Branth og Grønlund p. 493, *Bacidia citrinella*.

Loc.: Danmarks Havn (on the ground), Varde Ridge (on raw humus).

Lecidea Ach.

56. **Lecidea fuscoatra** L. Lich. arct. p. 210. — Branth og Grønlund p. 502.

Loc.: Renskæret (on stones).

57. **Lecidea lapicida** (Ach.) Fr. Lich. arct. p. 211. — Branth og Grønlund p. 499.

Loc.: Danmarks Havn (on stones).

58. **Lecidea auriculata** Th. Fr. Lich. arct. p. 213. — Branth og Grønlund p. 499.

Loc.: Danmarks Havn (on stones), Orléans Island (on stones).

59. **Lecidea sabuletorum** (Schreb.) Ach. Lich. arct. p. 214. — Branth og Grønlund p. 500.

Loc.: Danmarks Havn (on dry ground above dead moss). The material belonged to the variety *muscorum* (Wulf.).

60. **Lecidea enteroleuca** Ach. Lich. arct. p. 216. — Branth og Grønlund p. 500.

Loc.: Danmarks Havn (on stones).

61. **Lecidea atrobrunnea** Ram. Lich. arct. p. 218. — Branth og Grønlund p. 502.

Loc.: Renskæret (on stones).

62. **Lecidea limosa** Ach. Lich. scandinav. p. 538. — Branth og Grønlund p. 501.

Sporostatia Mass.

63. **Sporostatia Morio** Ram. Lich. arct. p. 224. — Branth og Grønlund p. 503.

Loc.: North Koldewey Island (on stones), Danmarks Havn (on stones). — All the specimens belonged to the variety *coracina* Smrft.

Buellia D. Not.

64. **Buellia insignis** Naeg. Lich. arct. p. 227. — Branth og Grønlund p. 504.

Loc.: Danmarks Havn (on the ground). — The whole of the material belonged to the variety *papillata* Smrft.

65. **Buellia triphragmioides** Anzi. Lich. scandinav. p. 594.

Loc.: Danmarks Havn (on moss).

Rhizocarpon Ram.

66. **Rhizocarpon geminatum** Flot. Lich. arct. p. 234. — Branth og Grønlund p. 507.

Loc.: Termometerfjeld (on stones), Danmarks Havn (on stones), Renskæret (on a large piece of quartz).

67. **Rhizocarpon geographicum** L. Lich. arct. p. 236. — Branth og Grønlund p. 507.

Loc.: Danmarks Havn (on stones).

Sphaerophorus Pers.

68. **Sphaerophorus coralloides** Pers. Lich. arct. p. 244. — Branth og Grønlund p. 508.

Loc.: Renskæret (on ground among moss).

X.

DIATOMS FROM NORTH-EAST GREENLAND

(N. OF 76° N. LAT.)

COLLECTED BY THE "DANMARK-EXPEDITION"

DETERMINED

BY

ERNST ØSTRUP

1910

The material on which the present work is based was given to me for investigation by the Commission for the "Danmark-Expedition."

The saltwater material consisted of (1) 13 **samples of Algæ,** as follows: —

Off **Cape Amélie**, 5 samples, preserved in glass vessels. The locality given in the text as "Off **Cape Amélie**."

Danmarks Havn, 3 samples, of which two are herbarium-material, and one in a glass vessel. The locality given in the text as "**Danmarks Havn**."

Along the peninsula, Cape Bismarck, 1 sample in a glass vessel. The locality in the text given as "Off Cape Bismarck."

Koldewey Ø, 4 samples, of which three are herbarium-material, and one in a glass vessel. The locality given in the text as "**Koldewey Isl.**"

and (2) **A series of samples from ice,** all preserved in glass vessels, 6 in all, as follows: —

76°20 N. lat., 18°20 W. long., land-ice off Germania Land, 1 sample. Given in the text as "Land-Ice."

75°14 N. lat., 4°34 W. long. The outer edge of the pack-ice, 4 samples. Given in the text as "**Margin of the Pack-Ice**."

75°14 N. Lat., 11°15 W. long., pack-ice, 1 sample. Given in the text as "**Pack-Ice**."

The freshwater samples are the same as those given to Dr. F. Börgesen for investigation of the freshwater algæ. There are in all 30 samples, partly preserved in glass vessels, and partly dried, in paper bags, but several of them contained such small quantities of material that it proved impossible to obtain serviceable preparations from the uncleansed material, let alone to submit it to a chemical cleansing! The freshwater samples are distributed among the different localities (the names of which are given unaltered in the text) as follows: —

Mallemukfjeld ..... 1 sample: some pebbles.
Hvalrosodde ..... 5 samples, of which 4 in glass vessels, 1 dried material.
Dove Bugt..... 1 sample, dried powder.
Lille Snenæs ..... 3 samples, of which 2 in glass vessels, 1: stone.
Snenæs..... 1 sample in a glass vessel.
Stormbugt..... 1 sample: two bones.
Stormkap ..... 1 sample, dried material.
Danmarks Havn .... 2 samples in glass vessels.
Yderbugten..... 1 sample, dried material.
Vester Elv..... 7 samples, all in glass vessels.
Basiskæret ..... 1 sample in a glass vessel.
Thermometerfjeld... 3 samples, of which 2 dried material, 1: stone.
Cape Bismarck ..... 1 sample in a glass vessel.
Nostoc..... 1 sample, dried material.
Without locality.... 1 sample in a glass vessel.

As regards the distribution of the Diatoms collected by the "Danmark Expedition," I have, in the present work, exclusively considered the distribution within the Arctic region, and then I have used the following method: —

In regard to the **marine forms**: —

W. Greenl. denotes a form found along the coasts of West Greenland.
E. Greenl. — a form found along the coasts of East Greenland.
Greenl. — a form found along the coasts of both East and West Greenland.
E. of Greenl. — a form found by Ryder's Expedition on the ice or in plankton, and included in my Mar. D. f. Østg.
East Arct. S. — a form found in one of the other eastern Arctic Seas as far as the Strait of Behring.

In regard to the **freshwater forms**: —

W. Greenl. denotes West Greenland.
E. Greenl. — East Greenland.
Fz. Js. Ld. — Franz-Josef Land.
Spb. — Spitzbergen.
B. El. — Beeren Eiland.
J. M. — Jan Mayen.

MARINE DIATOMS.

PENNATÆ.

Diraphideæ.

Amphiprora Ehr., 1843.

Amphiprora gigantea Grun. var. *septentrionalis* Grun. Cl. Syn., I, 18; Cl. & Grun. A. D., Tab. V, fig. 87 (A. decussata sept.).

Loc. Danmarks Havn (Algæ), Marg. of the Pack-Ice.
Arct. Distr. Greenl., East Arct. S.

Kjellmanii Cl. var. *glacialis* Cl., Cl. Syn., I, 16; Cl. Vega Exp., Tab. XXXV, fig. 12 (A. glac.).

Loc. Marg. of the Pack-Ice.
Arct. Distr. E. Greenl., East Arct. S.

Auricula Castr., 1875.

Auricula minuta Cl., Cl. Syn., I, 21, Tab. I, figs. 7—8.

Loc. Off Cape Amélie (Algæ).
Hitherto recorded only from "Sweden, Gullmarsfjord on Zostera and among Amphipleura (Berkeleya) Dillwynii" (Cl. l. c.).

Tropidoneis Cl., 1891.

Tropidoneis longa Cl., Cl. Syn., I, 25, Tab. III, fig. 8.

Loc. Off Cape Amélie (Algæ).
Arct. Distr. Greenl., East Arct. S.

Pleurosigma W. Sm., 1852.

Pleurosigma elongatum W. Sm., Cl. Syn., I, 38; W. Sm. Syn. Tab. XX, fig. 199.

Loc. Koldewey Isl. (Algæ).
Arct. Distr. Greenl., East Arct. S.

Caloneis Cl., 1894.

Caloneis amphisbæna (Bory) Cl. var. *fuscata* Schum., Cl. Syn., I, 58; Cl. & Grun. A. D., Tab. I, fig. 27.

Loc. Dove Bugt.
Arct. Distr. East Arct. S.

Caloneis brevis (Greg.) Cl., Cl. Syn., I, 61; V. H. Trt., Tab. IV, fig. 180. (Nav. brev.).

Loc. Off Cape Amélie (Algæ, 3 sampl.)
Arct. Distr. W. Greenl., East Arct. S.

Caloneis kryophila Cl. var? *gelida* Cl., Cl. Syn., I, 64; Cl. Vega Exp., Tab. XXXVII, fig. 42. (Nav. kryoph.? gel.)

Loc. Marg. of the Pack-Ice (2 sampl.)
Arct. Distr. Greenl., East Arct. S.

Diploneis Ehr., 1840.

Diploneis borealis (Grun.) Cl., Cl. Syn., I, 96; Grun. Fz. Js. L., Tab. I, fig. 40 (Nav. Smithii bor.).

Loc. Off Cape Amélie (Algæ, 5 sampl.), Koldewey Isl. (Algæ).
Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Diploneis coffæiformis (A. Sch.) Cl., Cl. Syn., I, 81; A. Sch. N. S. D., Tab. I, fig. 22.

Loc. Koldewey Isl. (Algæ).
Not before recorded from Arct. S. Several other records.

Diploneis Entomon Ehr., Cl. Syn., I, 87; Cl. & Grun. A. D., Tab. III, fig. 54 (Nav. bomboides A. Sch. var. media Grun.).

Loc. Danmarks Havn (Algæ), Koldewey Isl., (Algæ, 2 sampl.), Marg. of the Pack-Ice.
Arct. Distr. E. Greenl., East Arct. S.

Diploneis interrupta (Kütz.) Cl., Cl. Syn., I, 84; V. H. Trt., Tab. III, fig. 145.

Loc. Off Cape Amélie (Algæ, 2 sampl.), Koldewey Isl. (Algæ, 2 sampl.).
Arct. Distr. E. of Greenl., East Arct. S.

Diploneis littoralis (Donk.), Cl. var. *arctica* Cl., Cl. Baff. B., 18, Tab. I, fig. 7.

Loc. Marg. of the Pack-Ice (3 sampl.).
Arct. Distr. Davis Strait, E. of Greenl., East Arct. S.
In one of these samples a specimen of the present species has the following dimensions: Long. 66 μ, Lat. 25 μ.

Diploneis littoralis (Donk.), Cl. var. *hyperborea* Cl., Cl. l. c., Tab. I, fig. 1.

Loc. Marg. of the Pack-Ice.
Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Diploneis muscæformis (Grun.) Cl. var. *genuina* Cl., Cl. Syn., I, 83; A. S. Atl., Tab. XIII, fig. 47 (Navic. muscæf.).

Loc. Off Cape Amélie (Algæ).
Hitherto recorded only from Baku, Java and Camp. Bay.

Diploneis Smithii (Bréb.) Cl.. Cl. Syn., I, 96; W. Sm. Syn., Tab. XVII, fig. 152 a (Nav elliptic); Grun. Fz. Js. L., Tab. I, fig. 41.

Loc. Off Cape Amélie (Algæ, 3 sampl.), Danmarks Havn (Algæ, 2 sampl.).
Arct. Distr. Greenl., East Arct. S.

Diploneis splendida (Greg.) Cl., Cl. Syn., I, 87; A. Sch. N. S. D., Tab. I, fig. 3.

Loc. Danmarks Havn (Algæ), Koldewey Isl. (Algæ).
Arct. Distr. Greenl., East Arct. S.

Diploneis subcincta (A. Sch.) Cl., Cl. Syn., I, 86; Grun. Fz. Js. Ld., Tab. I, figs. 38—39.

Loc. Off Cape Amélie (Algæ, 4 sampl.), Danmarks Havn (Algæ), Koldewey Isl. (Algæ, 3 sampl.).
Arct. Distr. E. Greenl., East Arct. S.

Diploneis vacillans A. Sch. forma *β*, Cl. Syn., I, 95; A. S. Atl., Tab. VIII, fig. 34.

Loc. Off Cape Amélie (Algæ).
Not before recorded from Arct. S. Several other records.

Naviculæ fusiformes Cl., 1894.

Navicula fusiformis, Grun. var. *ostrearia* Gaillon, Cl. Syn., I, 106; V. H. Trt., Tab. XXVII, fig. 769.

Loc. Koldewey Isl. (Algæ).
Not before recorded from Arct. S. Several other records.

Naviculæ orthostichæ Cl., 1894.

Navicula kryokonites Cl. var. *subprotracta*, Cl. Syn., I, 109; Cl. Vega Exp., Tab. XXXVII, fig. 46.

Loc. Marg. of the Pack-Ice (3 sampl.).
Arct. Distr. E. of Greenl., East Arct. S.

Navicula rostelloides sp. nova. Tab. nost. XIII fig. 1. cf. Øst. Mar. D. Østg., 426, Tab. VI, fig. 73 (Nav. Rostellum W. Sm.).

Long. 22 *μ*. Lat. 10 *μ*. Str. minime 22 in 10 *μ*.

Valva lanceolata-elliptica, apicibus brevissime subrostratis. Raphe area hyalina angustissima, distincta autem, cincta. Striis parallelis, apices versus subradiantibus et, qvoad perspicere potui, altera in parte media valvæ deficientibus ibiqve fasciam unilateralem male definitam relinqventibus.

Loc. Marg. of the Pack-Ice.
Arct. Distr. E. of Greenl.

I had previously given this species as Nav. Rostellum W. Sm., which Cleve (Syn., II, 4) refers to Nav. Placenta Ehr. If, however, Nav. Rostellum should prove to be identical with Nav. Placenta then the present species cannot be Nav. Rostell., because it has not got the characteristic decussate striation of Nav. Placenta. As I have not been able to see any punctation of the striæ I place it, but with hesitation, under *Naviculæ orthostichæ* and as perhaps most nearly allied to *Nav. kryokonites* Cl.

Navicula Spicula (Hickie) Cl., Cl. Syn., I, 110; V. H. Trt., Tab. I, fig. 53 (Stauron. Spic.).

Loc. Marg. of the Pack-Ice.
Arct. Distr. E. of Greenl., East Arct. S.

Navicula Wankaremæ Cl., Cl. Syn., I, 109; Cl. Vega Exp., Tab. XXXVII, fig. 47 (Nav. kryokonites? Wank.).

Loc. Pack-Ice, Marg. of the Pack-Ice.
Arct. Distr. East Arct. S.

Navicula vitrea Cl., Cl. Syn., I, 111; Cl. & Grun., A. D., Tab. IV, fig. 78 (Pleurosigma vitreum).

Loc. Marg. of the Pack-Ice.
Arct. Distr. Davis Strait, E. of Greenl., East Arct. S.

Gyrosigma Hass., 1845.

Gyrosigma arcticum Cl., Cl. Syn., I, 119; Perag. Pleuros., Tab. X, figs. 16—17 (Rhoicosigma arct.).

Loc. Off Cape Amélie (Algæ, 2 sampl.), Marg. of the Pack-Ice (2 sampl.).
Arct. Distr. W. Greenl., East Arct. S.

Amphipleura Kütz., 1844.

Amphipleura rutilans Trentepohl, Cl. Syn., I, 126; V. H. Trt., Tab. V, fig. 255 (Berkeleya Dillwynii).

Loc. Koldewey Isl. (Algæ, 2 sampl.).
Arct. Distr. Greenl.

Amphipleura rutilans Trentepohl var. *antarctica* (Harvey) Grun., V. H. Syn., Tab. XVI, fig. 20 (Berkeleya antarct.).

Loc. Koldewey Isl. (Algæ).
Not before recorded from Arct. S. Other records, North Sea, Falkland Isls., Friendly Isls. (Cl. l. c.).

Naviculæ decipientes Grun., 1880.

Navicula subinflata Grun., Cl. Syn., I, 141; (Cl. Vega Exp., Tab. XXXVII, fig. 50). V. H. Trt., Tab. XXVII, fig. 760.

Loc. Off Cape Amélie (Algæ, 2 sampl.), Marg. of the Pack-Ice.
Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Naviculæ microstigmaticæ Cl., 1894.

Stauroneis perpusilla Grun., Cl. Syn., I, 146; Grun., Fz. Js. L., Tab. I, fig. 50.

Loc. Marg. of the Pack-Ice (3 sampl.).
Arct. Distr. E. of Greenl., East Arct. S.

Stauroneis pellucida, Cl. var. *contracta* Øst., Øst. Mar. D. Østg., 440, Tab. V, fig. 62.

Loc. Marg. of the Pack Ice.
Arct. Distr. E. of Greenl.

Navicula Grevillei Ag., Cl. Syn., I, 152; V. H. Trt., Tab. V, fig. 243 (Schizonema Grev.).

Loc. Off Cape Amélie (Algæ), 2 sampl.).
Arct. Distr. Greenl., East Arct. S.

Navicula rhombica Greg., Cl. Syn., I, 152; Greg. T. M. S., IV, Tab. V, fig. 1.

Loc. Koldewey Isl. (Algæ).
Arct. Distr. W. Greenl.

Navicula scopulorum Bréb., var *arctica* var. nova. Tab. nost XIII, fig. 10.

Long. 57 μ. Lat. 7 μ. Str. minime 22 in 10 μ, debilissimis et ægre perpiciendis.

Valva lineari, inter apices rôtundatos et mediam partem leniter contracta. Raphe area distincta hyalina cincta. Striis parallelis, sub apices, qvoad perspicere potui, convergentibus, media in parte valvæ deficientibus fasciamqve latam relinqventibus. Nodulis terminalibus ab apicibus remotis.

Loc. Koldewey Isl. (Algæ).

This form is probably most nearly allied to Nav. Scop. Bréb var. *belgica* H. V. H. (cf. Perag. Mar. Diat. d. Fr., Tab. VIII, fig. 27).

Gomphonema Ag., 1824.

Gomphonema exiguum Kütz., var. *arcticum* Grun., Cl. Syn., I, 188; V. H. Syn., Tab. XXV, fig. 30 (Gomph. arctic.).

Loc. Off Cape Amélie (Algæ), Pack-Ice.
Arct. Distr. Greenl., East Arct. S.

Gomphonema groenlandicum Øst., Øst. Mar. D. Østg., 414; Tab. III, figs. 11—12.

Loc. Koldewey Isl. (Algæ), Off Germ. L. (Land-Ice), Marg. of the Pack-Ice (3 sampl.).
Arct. Distr. Davis Strait., E. of Greenl., East Arct. S.

Gomphonema kamtschaticum Grun., Cl. Syn., I, 188; V. H. Syn., Tab. XXV, fig. 29.

Loc. Danmarks Havn (Algæ), Koldewey Isl. (Algæ, 3 sampl.).
Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Gomphonema septentrionale Øst., Øst. Mar. Diat. Østg., 414, Tab. III, fig. 9.

Loc. Pack-Ice, Marg. of the Pack-Ice.
Arct. Distr. E. of Greenl.

Gomphonema septentrionale Ost., var. *angustum* Øst., Øst. l. c., fig. 10.

Loc. Pack-Ice, Marg. of the Pack-Ice.
Arct. Distr. E. of Greenl.

Trachyneis Cl., 1894.

Trachyneis aspera (Ehr.) Cl., var. *genuina* Cl., Cl. Syn., I, 191; V. H. Trt., Tab. IV, fig. 165 (Nav. asp.).

Loc. Off Cape Amélie (Algæ).

Not before recorded from Arct. S. Several other records.

Trachyneis aspera (Ehr.) Cl., var. *vulgaris* Cl., A. S. Atl., Tab. XLVIII, figs. 2—6 (Nav. asp.).

Loc. Koldewey Isl. (Algæ).

Arct. Distr. W. Greenl.

Trachyneis aspera (Ehr.) Cl., var. *intermedia* Grun., A. S. Atl., l. c. fig. 14.

Loc. Off Cape Amélie (Algæ, 5 sampl.), Danmarks Havn (Algæ), Off Cape Bismarck (Algæ), Koldewey Isl. (Algæ, 2 sampl.), Marg. of the Pack-Ice.

Arct. Distr. Greenl., E. of Greenl., East Arct. S.

Trachyneis aspera (Ehr.) Cl., var. *intermedia* Grun. *forma robusta*. Tab. nost XIII, fig. 3.

Long. 250 μ. Lat. 38 μ. Ser. alveol. 6 in 10 μ, alveol. 4 in 10 μ.

Loc. Off Cape Amélie (Algæ).

I think this form may be a robust, sculptured *Trach. asp. intem.* Only a fragment found.

Naviculæ minusculæ Cl., 1895.

Navicula bahusiensis Grun., var. *arctica* Grun. Fz. Js. Ld., 52, Tab. 1, fig. 43. Øst. Mar. D. Østg., Tab. IV, figs. 30—31 (Nav. bahus. Grun?).

Loc. Dove Bugt.

Arct. Distr. E. of Green., East Arct. S.

The present form is identical with the fig. 31, quoted above, in my Mar. D. Østg. As I have there pointed out, my specimens as well as the present form, differ from Grunow's figure of a specimen from Fz. Js. L., in that the striæ at the apices are not radiate, but almost parallel. As the striæ, however, are seen only with great difficulty I think my determination may be correct.

Naviculæ lineolatæ Cl., 1895.

Navicula ammophila Grun., var. *intermedia* Grun., Cl. Syn., II, 30; Grun. D. Øst.—Ung., Tab. XXX, figs. 71—73 (Nav. ammoph. f. minuta).

Loc. Off Cape Amélie (Algæ), Danmarks Havn (Algæ), Koldewey Isl. (Algæ).

Arct. Distr. East Arct. S.

Navicula Bolleana Grun., Cl. Syn., II, 25; A. S. Atl., Tab. XLVII, fig. 18.

Loc. Marg. of the Pack-Ice.

Arct. Distr. W. Greenl., East Arct. S.

Navicula Bolleana Grun., var. *intermedia* Øst., Øst. Mar. D. Østg., 431, Tab. V, fig. 5.

Loc. Margin of the Pack-Ice.
Arct. Distr. E. of Greenl.

Navicula cancellata Donk., Cl. Syn., II, 30; V. H. Trt., Tab. III, fig. 128.

Loc. Marg. of the Pack-Ice,
Arct. Distr. Greenl., East Arct. S.

Navicula cancellata Donk., var. *Gregorii* Ralfs, A. S. Atl., Tab. XLVI, fig. 72.

Loc. Off Cape Amélie (Algæ), Koldewey Isl. (Algæ).
Arct. Distr. E. of Greenl., East Arct. S.

Navicula cancellata Donk., var. *retusa* Bréb, V. H. Trt., Tab. II, fig. 80 (Nav. retusa var. subret.).

Loc. Koldewey Isl. (Algæ, 2 sampl.), Off Germ. L. (Land-Ice).
Arct. Distr. East Arct. S.

Navicula cancellata Donk., var. *subapiculata* Grun., A. S. Atl., Tab. XLVI, fig. 68.

Loc. Koldewey Isl. (Algæ).
Arct. Distr. W. Greenl., East Arct. S.

Navicula digito-radiata Greg., Cl. Syn., II, 20; V. H. Trt., Tab. III, fig. 130.

Loc. Off Cape Amélie (Algæ, 2 sampl.).
Arct. Distr. Greenl., E. of Greenl., East. Arct. S.

Navicula digito-radiata Greg., var. *Cyprinus* (Ehr.?) W. Sm., V. H. Trt. l. c. fig. 131.

Loc. Off. Cape Amélie (Algæ, 2 sampl.).
Arct. Distr. Greenl.

Navicula directa W. Sm., var. *genuina* Cl., Cl. Syn., II, 27; A. S. Atl., Tab. XLVII, figs. 4—5.

Loc. Off Cape Amélie (Algæ, 5 sampl.), Koldewey Isl. (Algæ, 2 sampl.), Marg. of the Pack-Ice.
Arct. Distr. Greenl., East Arct. S.

Navicula directa W. Sm., var *lata* Øst., Øst. Mar. D. Østg., 427, Tab. V, fig. 47.

Loc. Off Cape Amélie (Algæ).
Arct. Distr. E. of Greenl.
In my paper Mar. D. Østg. (l. c.) the length of the valve is erroneously stated to be 0.37 mm instead of 0.137 mm. The figure, however, is correct.

Navicula directa W. Sm., var. *remota* Grun. A. Sch. N. S. D., Tab. III, fig. 2.

Loc. Danmarks Havn (Algæ).
Arct. Distr. Greenl., East Arct. S.

Navicula directa W. Sm., var. *cuneata* Øst., Øst. Mar. D. Østg., 428, Tab. IV, fig. 42.

Loc. Marg. of the Pack-Ice.
Arct. Distr. E. of Greenl.

Navicula distans W. Sm., Cl. Syn. II, 35; V. H. Trt., Tab. III, fig. 133.

Loc. Koldewey Isl. (Algæ), Marg. of the Pack-Ice.
Arct. Distr. W. Greenl., E. of Green., East Arct. S.

Navicula inflexa Greg., Cl. Syn., II, 31; V. H. Trt., Tab. XXV, fig. 713.

Loc. Off Cape Amélie (Algæ).
Arct. Distr. East Arct. S.

Navicula jamalinensis Cl., var. *subcircularis* var. nova. Tab. nost XIII, fig. 2.

Long. 35 μ. Lat. 24 μ. Str. 7—8 in 10 μ, sub apices 10 in 10 μ, distincte transverse lineatis.

Valva elliptica fere subcirculari. Raphe area hyalina, satis augusta, cincta. Striis radiantibus. Nodulis terminalibus extremis in apicibus situatis.

Loc. Danmarks Havn (Algæ).

This form may be a variety of *Nav. Jamal.* (cf. Cl. Syn., II, 38; Cl. Grun. A. D., Tab. II, fig. 40). It differs from the main species by its almost circular outline and by its apical area being much narrower and more linear than in Nav. Jamal.

Navicula jejuna A. Sch., var. *arctica* var. nova. Tab. nost XIII, fig. 5.

Long 68 μ. Lat. 8.5 μ. Str. 8 in 10 μ, obscure punctatis.

Valva lineari, apices versus leniter attenuata. Striis radiantibus, uno in latere valvæ raphen non attingentibus. Raphe sub apices sinuosa.

Loc. Marg. of the Pack-Ice.

This form has some resemblance to *Navicula jejunoides* H. O. H. (Belgica Exp., II, Tab. I, fig. 12) but its striæ are radiate throughout, and are equally distant upon both sides of the raphe.

The habitat of *Nav. jejunoides*, according to H. Van Heurch (l. c.), is "Glace de banquise No. 141; assez frequent."

Navicula kariana Grun., var. *detersa* Grun., Cl. Syn. II, 28; Grun. Fz. Js. L., Tab. 1, figs. 23—24.

Loc. Marg. of the Pack-Ice (3 sampl.).
Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Navicula kariana Grun., var. *frigida* Grun. Grun. l. c. fig. 25.

Loc. Marg. of the Pack-Ice (2 sampl.).
Arct. Distr. W. Greenl., East Arct. S.

Navicula (Schizonema) mollis W. Sm., Cl. Syn., II, 26; V. H. Syn., Tab. XV, figs. 22—23.

Loc. Danmarks Havn (Algæ), Koldewey Isl. (Algæ).
Arct. Distr. W. Greenl.

Navicula obtusa Cl., Cl. Syn., II, 29; Cl. Vega Exp., Tab. XXXVI, fig. 25.

Loc. Marg. of the Pack-Ice (2 sampl.).
Arct. Distr. Davis Strait, E. of Greenl., East Arct.

Navicula peregrina Ehr., Cl. Syn,, II, 18; V. H. Trt., Tab. III, fig. 101.

Loc. Off Cape Amélie (Algæ, 2 sampl.).
Arct. Distr. W. Greenl., East Arct. S.

Navicula peregrina Ehr., var. *kefvingensis* Ehr., A. S. Atl., Tab. XLVII, fig. 62.

Loc. Yderbugten.
Hitherto recorded only from Firth of Tay and Franzensbad (fossil) (Cl. l. c.).

Navicula peregrina Ehr., var.? *oblonga* var. nova. Tab. nost XIII, fig. 4.

Long. 43 μ. Lat. 10 μ. Str. 11 in 10 μ transverse lineatis.

Valva lineare-elliptica, apicibus rotundatis. Raphe area augusta hyalina, media in parte valvæ in aream transapicalem curtam dilatata, cincta. Striis radiantibus, sub apices fere parallelis.

Loc. Marg. of the Pack-Ice.
I am uncertain as to the systematic position of this form. I think it may be related to the group belonging to *Navicula peregrina*, perhaps it is nearest to *Nav. peregr. Meniscus.*

Navicula (Schizonema) ramosissima Ag., *forma genuina*, Cl. Syn., II, 26; V. H. Trt., Tab. V, fig. 244.

Loc. Off Cape Amélie (Algæ), Danmarks Havn (Algæ, 2 sampl.), Koldewey Isl. (Algæ, 2 sampl.).
Arct. Distr. Greenl.

Navicula sibirica Grun., Cl. Syn., II, 29; Cl. Vega Exp., Tab. XXXVII, fig. 38 (Rhoikoneis Bolleana var.? sib.).

Loc. Marg. of the Pack-Ice (2 sampl.).
Arct. Distr. Davis Strait, E. of Greenl., East Arct. S.

Navicula subcuneata sp. nova. Tab. nost XIII, fig. 6.

Long. 32 μ. Lat. 10 μ. Str. 10 in 10 μ, distincte punctatis.

Valva sublineari, apicibus subcuneatis. Raphe area distincta hyalina cincta. Striis parallelis sub apices leniter radiantibus. Nodulis terminalibus extremis in apicibus situatis.

Loc. Danmarks Havn (Algæ).
This form may be akin to an undescribed *Navicula* in A. S. Atl., Tab. XLVI, fig. 9 (from Quarnero), but it has parallel striæ; the *Navicula*, delineated by A. Schmidt, has the striæ slightly radiate.

Navicula superba Cl., Cl. Syn., II, 29; Cl. Vega Exp., Tab. XXXVI, fig. 23.

Loc. Danmarks Havn (Algæ), Koldewey Isl. (Algæ), Marg. of the Pack-Ice (3 sampl.).
Arct. Distr. Davis Strait, E. Greenl., E. of Greenl., East Arct. S.

Navicula superba Cl., var. *subacuta* Gran. A. S. Atl., Tab. CCLIX, figs. 27—28.

Loc. Marg. of the Pack-Ice.
Arct. Distr. East Arct. S.

Navicula transitans Cl., Cl. Syn., II, 27; Cl. Vega Exp., Tab. XXXVI, fig. 31.

Loc. Pack-Ice, Marg. of the Pack-Ice (3 sampl.).
Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Navicula trigonocephala Cl., Cl. Syn., II, 27; Cl. Vega Exp., Tab. XXXVI, fig. 29.

Loc. Pack-Ice, Marg. of the Pack-Ice (4 sampl.).
Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Navicula valida Cl. & Grun., Cl. Syn., II, 25; Cl. & Grun. A. D., Tab. II, fig. 29.

Loc. Marg. of the Pack-Ice.
Arct. Distr. E. Greenl., E. of Greenl., East Arct. S.

Navicula valida Cl. & Grun., *forma minor*. Tab. nost XIII, fig. 8.

Long. 46 μ. Lat. 16 μ. Str. 8 in 10 μ, transverse lineatis.

Valva elongate-elliptica. Raphe area distincta hyalina cincta. Striis radiantibus, media in parte valvæ alternatim longis abbreviatisqve.

Loc. Marg. of the Pack-Ice.

Undoubtedly a narrower and smaller form, intermediate between Nav. valida and *Nav. valida minuta* (Cl. l. c.).

Navicula Zostereti Grun., Cl. Syn., II, 31; A. S. Atl., Tab. XLVII, figs. 42—44.

Loc. Off Cape Amélie (Algæ), Koldewey Isl. (Algæ), Marg. of the Pack-Ice (3 sampl.).
Arct. Distr. E. of Greenl.

Navicula? gomphonemoides sp. nova. Tab. nost XIII, fig. 7.

Long. 32 μ. Lat. 5 μ. Str. 10 in 10 μ, delicatissime punctatis.

Valva anguste-lanceolata. Raphe leniter sinuosa. Striis radiantibus, Raphen attingentibus, media modo in parte valvæ paululum abbreviatis. Nodulis terminalibus inconspicuis.

Loc. Danmarks Havn (Algæ).

This small form may perhaps be a Gomphonema. Only a single specimen found.

Naviculæ punctatæ Cl., 1895.

Navicula Baculus Cl., Cl. Vega Exp., 474, Tab. XXXVII, fig 51 (cf. Cl. Syn., I, 124: Stenoneis inconspicua (Greg) Cl. var. Baculus Cl.). A. S. Atl., Tab. CCLXII, fig. 13.

Loc. Marg. of the Pack-Ice.
Arct. Distr. E. of Greenl., East Arct. S.

I quite agree with Dr. H. Heiden when he says (in the explanation of the Table in A. S. Atl. quoted above): "Zu Stenoneis darf diese Species, wie Cleve es tut, nicht gestellt werden."

Navicula glacialis Cl., Cl. Syn., II, 40; Tab. I, fig. 28.

Loc. Off Cape Amélie (Algæ), Koldewey Isl. (Algæ).

Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Navicula glacialis, var. *septentrionalis* Cl., A. S. Atl., Tab. VI, fig. 37.

Loc. Koldewey Isl. (Algæ).

Arct. Distr. Greenl., East Arct. S.

Navicula punctulata W. Sm., var. *finmarchica* Grun., Cl. Syn., II, 47; Cl. & Grun. A. D., Tab. II, fig. 49 & Øst. Mar. D. Østg., Tab. VI, fig. 69.

Loc. Off Cape Amélie (Algæ, 4 sampl.), Koldewey Isl. (Algæ, 2 sampl.).

Arct. Distr. Greenl., East Arct. S.

Naviculæ lyratæ Cl., 1895.

Navicula Lyra Ehr., var. *arctica* var. nova. Tab. nost XIII, fig. 9.

Long. 46 μ. Lat. 21 μ. Str. 9—10 in 10 μ, delicatissime transverse lineatis.

Valva apices versus cuneata, media in parte marginibus fere parallelis. Media parte sulcorum, Lyram effingentium, stria sicut nebulosa instructa.

Loc. Koldewey Isl. (Algæ).

I think that this variety comes nearest to Nav. Lyra var. atlantica A. S.

Navicula pygmæa Kütz, Cl. Syn., II, 65; V. H. Trt., Tab. IV, 164.

Loc. Koldewey Isl. (Algæ, 2 sampl.), Marg. of the Pack-Ice.

Arct. Distr. East. Arct. S.

Navicula spectabilis Greg., Cl. Syn., II, 60; A. S. Atl., Tab. III, figs. 20—21.

Loc. Koldewey Isl. (Algæ).

Arct. Distr. Greenl.

Navicula spectabilis Grey., var. *densestriata* Øst., Øst. Mar. D. Østg., 436; Tab. VI, fig. 67.

Loc. Off Cape Amélie (Algæ. 2 sampl.), Koldewey Isl. (Algæ).

Arct. Distr. E. Greenl.

Pinnularia Ehr., 1843.

Marinæ Cl., 1895.

Pinnularia bistriata Leud. Fortm., Cl. Syn., II, 95; Perag. D. mar. d. Fr., Tab. XI, fig. 14.

Loc. Off Cape Amélie (Algæ), Koldewey Isl. (Algæ).

Hitherto recorded only from the Mediterranean, Ceylon, Labuan, Siam.

Pinnularia qvadratarea A. Sch., Cl. Syn., II, 95; A. Sch. N. S. D., Tab. III, fig. 26.

Loc. Off Cape Amélie (Algæ), Koldewey Isl. (Algæ), Marg. of the Pack-Ice.
Arct. Distr. Greenl., E. of Greenl., East Arct. S.

Pinnularia qvadratarea A. Sch., var. *constricta* Øst., Øst. Mar. D. Østg. 419, Tab. IV, fig. 23.

Loc. Marg. of the Pack-Ice (2 sampl.).
Arct. Distr. E. of Greenl., East Arct. S.

Pinnularia qvadratarea A. Sch., var. *dubia* Heiden, A. S. Atl., Tab. CCLX, fig. 13.

Loc. Marg. of the Pack-Ice.
Arct. Distr. East Arct. S.

Pinnularia qvadratarea A. Sch., var. *gibbosa* Øst., Øst. Mar. D. Østg., 420, Tab. IV, fig. 28.

Loc. Off Cape Amélie (Algæ).
Arct. Distr. E. of Greenl., East Arct. S.

Pinnularia Stuxbergii Cl., Cl. Syn., II, 96 (Pinn. qvadrat. Stuxb.) A. S. Atl., Tab. CCLX, figs. 37—38.

Loc. Off Germ. L. (Land-Ice), Marg. of the Pack-Ice (3 sampl.).
Arct. Distr. Davis Strait, E. of Greenl., E st Arct. S.

Amphora Ehr., 1840.

Subg. *Amphora* Cl., 1895.

Amphora gigantea Grun., Cl. Syn., II, 105. Tab. nost. XIII, fig. 11.
Long. 70 μ. Lat. 15 μ. Str. 7 in 10 μ.

Loc. Koldewey Isl. (Algæ).
Not before recorded from Arctic Seas. Several other records.
The present form is smaller than the typical species. I have given a figure of it, as it seems to me not to agree exactly with *Amph. gig.* forma *minor*. (Cl. l. c. A. S. Atl., Tab. XL, figs. 28—29).

Amphora marina (W. Sm.), H. V. H. Cl. Syn., II, 103; V. H. Trt., Tab. I, fig. 14.

Loc. Off Cape Amélie (Algæ), Danmarks Havn (Algæ), Koldewey Isl. (Algæ, 4 sampl.).
Arct. Distr. E. Greenl., E. of Greenl.

Amphora Proteus Greg., Cl. Syn., II, 103; A. S. Atl., Tab. XXVII, fig. 3.

Loc. Off Cape Amélie (Algæ, 4 sampl.), Koldewey Isl. (Algæ, 4 sampl.).
Arct. Distr. Greenl., East Arct. S.

Amphora Proteus Greg., var. *contigua* Cl., A. S. Atl., Tab. XXVII, figs. 7—9.

Loc. Off Cape Amélie (Algæ, 4 sampl.), Danmarks Havn (Algæ), Koldewey Isl. (Algæ, 2 sampl.).
Arct. Distr. E. Greenl.

Amphora virgata sp. nova. Tab. nost. XIII, fig. 12.
Long. 58 μ. Lat. 12 μ. Str. 10 in 10 μ, ad marginem numeratis.
Valva lunata, apicibus obtusis. Striis in parte dorsali valvæ

linea mediana nuda interruptis. Raphe propior linea altera, minus autem distincta, adest.

Loc. Danmarks Havn (Algæ).

This species may be a form intermediate between *Amphora ovalis* Kütz. and *Amph. Proteus* Greg.

Subgen. *Diplamphora* Cl., 1895.

Amphora crassa Greg., Cl. Syn., II, 109; A. S. Atl., Tab. XXVIII, figs. 30—33 (A. crass. punctata).

Loc. Off Cape Amélie (Algæ, 3 sampl.), Danmarks Havn (Algæ), Koldewey Isl. (Algæ).

Arct. Distr. Greenl., East Arct. S.

Amphora margaritifera Cl., Cl. Syn., II, 117; Tab. III, figs. 30—31, Øst. Kyst D. f. Grønl., 325; Tab. II, fig. 6 (A. cruciata Øst.).

Loc. Danmarks Havn (Algæ).

Arct. Distr. W. Greenl.

I am now quite sure that this form, which, in my paper quoted above, I recorded as a new species (referring however to its affinity to A. margar.) is identical with *A. marg.* Cl., a form from Galapagos Islands.

Subg. *Halamphora* Cl., 1895.

Amphora acutiuscula Kütz., Cl. Syn., II, 121; V. H. Trt., Tab. I, fig. 5.

Loc. Danmarks Havn (Algæ, 2 sampl.), Koldewey Isl. (Algæ).

Arct. Distr. W. Greenl., East Arct. S.

Amphora costata W. Sm., Cl. Syn., II, 122; W. Sm. Syn., Tab. XXX, fig. 253.

Loc. Danmarks Havn (Algæ), Koldewey Isl. (Algæ).

Arct. Distr. E. Greenl.

Amphora Eunotia Cl., Cl. Syn., II, 122; A. S. Atl., Tab. XXV, fig. 35.

Loc. Off Cape Amélie (Algæ, 3 sampl.), Koldewey Isl. (Algæ).

Arct. Distr. Greenl., East Arct. S.

Amphora granulata Greg., Cl. Syn., II, 123; Greg. D. Clyde, Tab. XIV, fig. 96.

Loc. Off Cape Amélie (Algæ).

Not before recorded from Arctic Seas. Other records, Scotland, South-Asia.

Amphora macilenta Greg., Cl. Syn., II, 121; Perag. D. mar. de Fr., Tab. L, fig. 26.

Loc. Off Cape Amélie (Algæ).

Not before recorded from Arctic Seas. According to Peragallo (l. c. p. 231): "Repandu."

Amphora Terroris Ehr., Cl. Syn., II, 122; A. S. Atl., Tab. XXV, figs. 17—19.

Loc. Off Cape Amélie (Algæ, 5 sampl.), Danmarks Havn (Algæ, 2 sampl.), Koldewey Isl. (Algæ, 2 sampl.).

Arct. Distr. Greenl., East Arct. S.

Amphora Terroris Ehr., var. *inflata* Øst., Øst. mar. D. Østg., 410, Tab. III, fig. 6 (Amphora inflata Grun.?).

Loc. Off Cape Amélie (Algæ, 4 sampl.), Koldewey Isl. (Algæ, 2 sampl.).
Arct. Distr. E. Greenl.

Especially because of the slight inward curvation of the apices I think this form may more correctly be referred to Amph. Terr.

Subg. *Oxyamphora* Cl., 1895.

Amphora lævis Greg., var. *lævissima* Greg., Cl. Syn., II, 130; A. S. Atl., Tab. XXVI, figs. 3, 13, 14.

Loc. Off Cape Amélie (Algæ).
Arct. Distr. E. of Greenl., East Arct. S.

Amphora lineolata Ehr., Cl. Syn., II, 126; V. H. Syn., Tab. I, fig. 13.

Loc. Danmarks Havn (Algæ), Koldewey Isl. (Algæ).
Arct. Distr. East Arct. S.

Subg. *Amblyamphora* Cl., 1895.

Amphora venusta sp. nova. Tab. nost. XIII, fig. 16.

Long. 68 μ. Lat. 10.8 μ. Str. 16—17 in 10 μ, punctatis.

Valva lunata, apicibus rotundatis paululum marginem ventralem versus inclinatis. Margine ventrali leniter arcuata. Striis dorsalibus Raphen attingentibus, striis ventralibus marginalibus.

Loc. Off Cape Amélie (Algæ), Koldewey Isl. (Algæ).

I am somewhat in doubt as to the systematic position of this species. It may perhaps be considered a slender form of Amphora obtusa Greg., Trans. M. S. V, 72, Tab. I, fig. 34.

Subg. *Cymbamphora* Cl., 1895.

Amphora angusta Greg., Cl. var. *typica* Cl., Cl. Syn., II, 135; A. S. Atl., Tab. XXV, fig. 15.

Loc. Off Cape Amélie (Algæ, 2 sampl.), Danmarks Havn (Algæ).
Arct. Distr. W. Greenl., East Arct. S.

Monoraphideæ.

Rhoicosphenia Grun., 1860.

Rhoicosphenia curvata Kütz., Cl. Syn., II, 165; V. H. Trt., Tab. VII, fig. 319.

Loc. Off Cape Amélie (Algæ, 3 sampl.), Danmarks Havn (Algæ, 2 sampl.), Koldewey Isl. (Algæ).
Arct. Distr. Greenl., E. of Greenl., East Arct. S.

Cocconeis (Ehr., 1835) Grun., 1868
subgen. *Cocconeis* Cl., 1895 pro gen.

Cocconeis Scutellum Ehr., var. *genuina* Cl., Cl. Syn., II, 170; V. H. Trt., Tab. VIII, fig. 338.

Loc. Danmarks Havn (Algæ, 2 sampl.), Koldewey Isl. (Algæ).
Arct. Distr. Greenl., East Arct. S.

Cocconeis Scutellum Ehr., var. *minutissima* Grun., Grun. Fz. Js. L., Tab. I, fig. 1.

Loc. Off Cape Amélie (Algæ).
Arct. Distr. Franz-Josef Land.

Cocconeis Scutellum Ehr., var. *californica* Grun., A. S. Atl., Tab. CXCI, figs. 40—43.

Loc. Danmarks Havn (Algæ), Off Cape Bismarck (Algæ), Koldewey Isl. (Algæ).
Hitherto recorded only from California and Kamtschatka.

Subg. *Eucocconeis* Cl., 1895 pro. gen.

Cocconeis dirupta Greg. var. *decipiens* Cl., Cl. Syn., II, 175; Cl. Arct. S., Tab. I, fig. 6 (Cocc. decip.) & Tab. II, fig. 11 a (Cocc. arctica).

Loc. Off Cape Amélie (Algæ), Danmarks Havn (Algæ), Koldewey Isl. (Algæ).
Arct. Distr. W. Greenl., East Arct. S.

Cocconeis pseudomarginata Greg., Cl. Syn., II, 178; V. H. Trt., Tab. XXIX, fig. 824.

Loc. Danmarks Havn (Algæ, 2 sampl.).
Arct. Distr. Greenl., East Arct. S.

Cocconeis septentrionalis Grun., Cl. Syn., II, 174; Grun. Fz. Js. L., Tab. I, fig. 2.

Loc. Off Cape Amélie (Algæ, 4 sampl.), Danmarks Havn (Algæ, 2 sampl.), Koldewey Isl. (Algæ, 2 sampl.), Marg. of the Pack-Ice.
Hitherto recorded only from Franz-Josef Land (Assistance Bay).

Subg. *Disconeis* Cl., 1895 pro. gen.

Cocconeis pinnata Greg., Cl. Syn., II, 181; V. H. Trt., Tab. XXIX, fig. 818.

Loc. Danmarks Havn (Algæ), Koldewey Isl. (Algæ, 2 sampl.).
Arct. Distr. East Arct. S.

Cocconeis pinnata var. *arctica* var. nova. Tab. nost. XIII, fig. 13.

Long. 24 μ. Lat. 11 μ. Costis 5,5 in 10 μ utrisqve in valvis, duplice serie punctorum alternantium interpositis. Valva elliptica apicibus paululum attenuatis. Epitheca: Area apicali satis angusta. Hypotheca: Raphe area angusta hyalina cincta. Costis utrisqve in valvis subradiantibus.

Loc. Danmarks Havn (Algæ).
This variety differs from the main species in its somewhat attenuated apices and its narrow apical area.

Subg. *Pleuroneis*, Cl., 1895 pro. gen.

Cocconeis costata Greg., Cl. Syn., II, 182; V. H. Trt., Tab. XXIX, fig. 816.

Loc. Off Cape Amélie (Algæ), Danmarks Havn (Algæ, 2 sampl.), Koldewey Isl. (Algæ, 4 sampl.).

Arct. Distr. Greenl., East Arct. S.

Cocconeis costata var. *pacifica* Grun., V. H. Syn., Tab. XXX, figs. 13—14.

Loc. Danmarks Havn (Algæ).

Arct. Distr. Greenl.

Cocconeis ornata Greg? cf. Greg. D. Clyde, 19, Tab. I, fig. 24. Tab. nost. XIII, Fig. 14.

Long 32 μ. Lat. 16 μ, costis 8 in 10 μ, utrisqve in valvis.

Valva elliptica, area apicali distincta. Costis leniter radiantibus, in Hypotheca vitta submarginali nuda interruptis.

Loc. Koldewey Isl. (Algæ).

This species may be Gregory's *Cocc. ornata*, although Gregory (l. c.) describes the apical area as a "long lanceolate blank space" and figures the striæ as strongly radiate towards the apices. Cleve (Syn. II, 171) mentions *Cocc. ornata* as a form which possibly may be a variety of *Cocc. Scutellum* Ehr., but in this matter I cannot agree with him. *Cocconeis ornata* occurs in "Lamlash Bay" and in "Loch Fine."

Cocconeis sp. Tab. nost. XIII, fig. 17.

Long. 31 μ. Lat. 20 μ. Str. 11 in 10 μ, ad marginem numeratis, delicatissime punctatis.

Hypotheca: Valva elliptica. Raphe area angusta distincta, media in parte valvæ in aream parvulam centralem acuminatam dilatata, cincta. Striis ubiqve in marginem perpendicularibus. Nodulis terminalibus paululum ab apicibus remotis. Hypothecam modo observavi.

Loc. Koldewey Isl. (Algæ).

As I have only seen the hypotheca I have not given this form as a new species.

Achnanthes Borg., 1822,

Subg. *Heteroneis* Cl., 1895, pro. gen.

Achnanthes hyperborea Grun., Cl. Syn., II, 183; Grun., Fz. Js. Ld., Tab. I, figs. 4—5. Tab nost. XIII, fig. 15.

Loc. Off Cape Amélie (Algæ).

Arct. Distr. Franz-Josef Land.

Subg. *Microneis* Cl., 1895 pro. gen.

Achanthes debilissima sp. nova? Tab. nost. XIII, fig. 24, cf. Grun., Fz. Js. Ld., 52, Tab. I, fig. 42 (Navicula debiliss. Grun.).

Long. 6,3—7 μ. Lat. 2,7 μ.

Valva elliptica. Striis perdifficiliter perspiciendis.

Loc. Koldewey Isl. (2 sampl).

This hyaline and exceedingly small species may be identical with Navicula debilissima Grun. Grunow's figure shows both the terminal nodules and a central nodule and the latter he describes in the text (l. c.) as "minu-

tissimo." As to the present specimens the matter stands as follows: — On all my specimens I have seen a median apical line (a "raphe" or an "apical area"), on some specimens I have observed the terminal nodules a little remote from the apices. On a few specimens I think I have seen a trace of a central nodule, but I am not quite sure of it and therefore I have not put a central nodule in my figures. On the other hand I have been able in some specimens to see a striation at right-angles to the apical axis. A specimen in zone-view, which I had the good fortune to observe showed the frustule bent along the transapical axis after the manner of an Achnanthes, but I have not been able to see the frustules united into a band, on the contrary I think I observed them attached separately to the narrow branches of other Algæ after the manner of a Cocconeis.

Achnanthes rhombica sp. nova. Tab. nost. XIII, fig. 18.

Long. 34 μ. Lat. 12 μ. Str. 11 in 10 μ, utrisqve in valvis, transverse lineatis.

Valva elongate-rhombica. Epitheca: Striis parallelis, area apicali distincta.

Hypotheca: Striis valde radiantibus, mediis aliqvantum spatiatis.

Raphe area hyalina, media in parte valvæ in aream conspicuam rotundatam dilatata, cincta.

Loc. Off Cape Amélie (Algæ).

The epitheca of this species resembles that of *Ach. Lorenziana* Grun., but is somewhat more closely striated. As I have seen both valves in situ I am quite certain that the present species cannot be *Achn. Lorenz.* in which the number of striæ on the hypotheca is stated to be 18—27 in 10 μ (cf. Cl. Syn., II, 187).

Achnanthes septentrionalis sp. nov. Tab. nost. XIII, fig. 21.

Long. 19 μ. Lat. 9 μ. Str. 11 in 10 μ utrisqve in valvis, transverse lineatis.

Valva lanceolata, apicibus subrostratis. Epitheca: Striis parallellis, area apicali distincta. Hypotheca: Striis radiantibus, media in parte valvæ aliqvantum spatiatis. Raphe area hyalina, media in valva in aream rotundatam dilatata, cincta.

Loc. Off Cape Amélie (Algæ).

Achnanthes septentrionalis var. *subcapitata* var. nova. Tab. nost. XIII, fig. 22.

This variety agrees entirely with the main species in the dimensions and the number of striæ, but differs in the subcapitate apices and in the absence of a central area on the hypotheca.

Loc. Off Cape Amélie (Algæ).

Achn. sept. is probably most nearly allied to *Achn. Hauckiana* Grun. (V. H. Syn., Tab. XXVII, figs. 14—15).

Subg. *Achnanthidium* (Kütz., 1844) Heib., 1864, Cl., 1895 pro. gen.

Achnanthes brevipes Ag. var. *typica*, Cl. Syn., II, 193; V. H. Trt., Tab. VIII, fig. 324.

Loc. Off Cape Amélie (Algæ, 3 sampl.), Danmarks Havn (Algæ), Off Cape Bismarck (Algæ), Koldewey Isl. (Algæ, 2 sampl.).
Arct. Distr. Greenl., East Arct. S.

Achnanthes brevipes Ag. var. *intermedia* Kütz. V. H. Trt., l. c. fig. 325 (Achn. subsessilis Ehr.).

Loc. Off Cape Amélie (Algæ, 3 sampl.), Danmarks Havn (Algæ), Koldewey Isl. (Algæ).
Arct. Distr. E. Greenl., East Arct. S.

Achnanthes brevipes Ag. var. *parvula* Kütz., V. H. Trt. l. c. fig. 326 (Achn. parvula).

Loc. Off Cape Amélie (Algæ, 2 sampl.).
Arct. Distr. Greenl.

Achnanthes brevipes Ag. var. *forma elliptica*, Øst. Kystd. f. Grönl., Tab. II, fig. 13.

Loc. Off Cape Amélie (Algæ), Koldewey Isl. (Algæ, 2 sampl.).
Arct. Distr. E. Greenl.

Achnanthes groenlandica Cl., Cl. Syn., II, 195; Cl. A. D., Tab. IV, fig. 23.

Loc. Off Cape Amélie (Algæ), Koldewey Isl. (Algæ).
Arct. Distr. Greenl., E. Arct. S.

KALYPTORAPHIDEÆ.

Eschatoraphideæ.

Surirella Turp., 1827.

Surirella insignis sp. nova. Tab. nost. XIII, fig. 19.

Long. 137 μ. Lat. 54 μ. Canaliculis 1,5 in 10 μ. Striis subtilissimis. Valva ovata, area apicali angusta. Striis delicatissimis, vix perspiciendis.

Loc. Danmarks Havn.
As I have not seen this species in zone-view I am uncertain of its systematic position. Possibly it may be considered a robust form of an unnamed *Surirella* from "Hayes Exp." figured in A. S. Atl., Tab. XXI, fig. 15, which I have recorded from E. Greenl (cf. Øst. Mar. D. Østg., p. 334).

Surirella Oestrupii Gran., Gran., F. N. Exp., 46; Øst. Mar. D. Østg., Tab. VI, fig. 68 (Sur. splendida var? minima).

Loc. Off Cape Amélie (Algæ).
Arct. Distr. E. Greenl., E. of Greenl., East Arct. S.

Campylodiscus Ehr., 1841.

Campylodiscus angularis Greg., V. H. Trt., 378, Tab. XXXV, fig. 909.

Loc. Off Cape Amélie (Algæ, 3 sampl.).
Arct. Distr. Greenl., East Arct. S.

Tropidoraphideæ.

Hantzschia Grun., 1877.

Hantzschia Weyprechtii Grun., Fz. Js. Ld., 55, Tab. I, fig. 60.

Loc. Koldewey Isl. (Algæ), Pack-Ice.
Arct. Distr. E. of Greenl., East Arct. S.

Nitzschia (Hass., 1845), Grun., 1880.

Tryblionella Grun., 1880.

Nitzschia Tryblionella Hantsch var. *levidensis* W. Sm., V. H. Trt. 385, Tab. XV, fig. 494.

Loc. Off Cape Amélie (Algæ).
Arct. Distr. E. Greenl. (in freshwater), East Arct. S.

Apiculatæ Grun., 1880.

Nitzschia marginulata Grun. var. *genuina* Grun. *forma minuta*? Cl. & Grun., A. D., 72. Tab. nost. XIII, fig. 20.

Long. 35 μ. Lat. 7 μ & 6 μ. Punct. carinal. 16 in 10 μ, striis delicatis, minime 23 in 10 μ.

Loc. Off Cape Amélie (5 sampl.).
This form may be the *forma minuta* (from Esquimault harbour) of *Nitz. marg. gen.*, of which Grunow has not given a figure.

Bilobatæ Grun., 1880.

Nitzschia bilobata W. Sm., V. H. Trt. 389, Tab. XV, fig. 512.

Loc. Danmarks Havn (Algæ).
Arct. Distr. W. Greenl.

Nitzschia hybrida Grun., Cl. & Grun. A. D., 79, V. H. Syn., Tab. LX, figs. 4—5.

Loc. Off Cape Amélie (Algæ).
Arct. Distr. E. of Greenl., East Arct. S.

Insignes Grun., 1880.

Nitzschia insignis W. Sm., var. *arctica* Grun., Cl. & Grun. A. D., 84; Øst. Mar. D. Østg., Tab. VII, fig. 81.

Loc. Off Cape Amélie (Algæ).
Arct. Distr. E. Greenl., East Arct. S.

Bacillaria Grun., 1880.

Nitzschia paradoxa (Gnsel.) Grun. V. H. Trt. 392, Tab. XVI, fig. 518.

Loc. Koldewey Isl. (Algæ).
Arct. Distr. East Arct. S.

Nitzschia socialis Greg. var. *kariana* Grun., Cl. & Grun. A. D. 85, Tab. VI, fig. 108.

Loc. Off Cape Amélie (Algæ, 2 sampl.), Danmarks Havn (Algæ).
Arct. Distr. East Arct. S.

Spathulatæ Grun., 1880.

Nitzschia angularis W. Sm. V. H. Trt. 393, Tab. XVI, fig. 521.

Loc. Off Cape Amélie (Algæ), Danmarks Havn (Algæ).
Arct. Distr. Greenl., E. of Greenl., East Arct. S.

Nitzschia angularis var. *borealis* Grun., Cl. & Grun. A. D. 89, Tab. V, fig. 99.

Loc. Off Cape Amélie (Algæ), Koldewey Isl. (Algæ).
Arct. Distr. Greenl., East Arct. S.

Nitzschia distans Greg. V. H. Trt. 394, Tab. XXXIII, fig. 878.

Loc. Off Cape Amélie (Algæ).
Arct. Distr. W. Greenl., East Arct. S.

Sigmoideæ Grun., 1880.

Nitzschia Brébissonii W. Sm., var. *borealis* Grun., Cl. Baff. B. 21, Tab. I, figs. 28—32; Øst. Mar. D. Østg., Tab. VII, fig. 80 (Nitz. socialis septentrionalis).

Loc. Danmarks Havn (Algæ).
Arct. Distr. Davis Strait, E. of Greenl., East Arct. S.

Nitzschia lævissima Grun., Grun. Fz. Js. Ld., 54, Tab. I, figs. 65—66.

Loc. Off Cape Amélie (Algæ), Marg. of the Pack-Ice (4 sampl.).
Arct. Distr. E. of Greenl., East Arct. S.

Sigmata Grun., 1880.

Nitzschia scabra Cl., Cl. Vega Exp. 480, Tab. XXXVIII, fig. 73.

Loc. Marg. of the Pack-Ice.
Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Nitzschia Sigma W. Sm. V. H. Trt. 396, Tab. XVI, fig. 531.

Loc. Off Cape Amélie (Algæ).
Arct. Distr. W. Greenl., East Arct. S.

Nitzschia Sigma W. Sm., var *robusta* var. nova. Tab. nost XIII, fig. 26.

Long. 270 μ. Lat. 10 μ. Punct. carinal. 2—3 in 10 μ, Str. 16—17 in 10 μ, distinte punctatis, carena admodum excentrica. Striis carenam versus obliterantibus.

Loc. Koldewey Isl. (Algæ).

I think this large *Nitzschia* may be related to the group belonging to *Nitz. Sigma*, perhaps it comes nearest to *Nitz. Sigma valida.*

Nitzschia Sigma W. Sm. var. *Sigmatella* Grun., V. H. Trt. 397, Tab. XVI, fig. 535.

Loc. Off Cape Amélie (Algæ).

Not before recorded from Arctic Seas. According to Perag. (Diat. mar. d. Fr. 290) "Repandu."

Nitzschia Sigma W. Sm., var. *valida* Cl. & Grun. *forma longissima.* V. H. Syn., Tab. LXV, fig. 4.

Loc. Koldewey Isl. (Algæ, 3 sampl.).

Arct. Distr. W. Greenl.

Lineares Grun., 1880.

Nitzschia polaris Grun. Grun. Fz. Js. Ld., 54, Tab. I, figs. 62—63.

Loc. Off Germ. L. (Land-Ice), Marg. of the Pack-Ice (4 sampl.).

Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Lanceolatæ Grun., 1880.

Nitzschia lanceolata W. Sm., V. H. Trt. 400, Tab. XVII, fig. 548.

Loc. Off Cape Amélie (Algæ, 2 sampl.), Koldewey Isl. (Algæ).

Arct. Distr. E. of Greenl.

Arraphideæ.

Synedra Ehr., 1831.

Synedra affinis Kütz., *genuina.* V. H. Trt. 314, Tab. X, fig. 430.

Loc. Off Cape Amélie (Algæ, 3 sampl.), Danmarks Havn (Algæ).

Synedra affinis Kütz., *acuminata* Grun., V. H. Syn., Tab. XLI, fig. 14.

Loc. Koldewey Isl. (Algæ).

Synedra affinis Kütz., *fasciculata* Kütz., V. H. Trt., Tab. X, fig. 433.

Loc. Off Cape Amélie (Algæ), Danmarks Havn (Algæ), Koldewey Isl. (Algæ).

Synedra affinis Kütz,, *hybrida* Grun. *forma elongata*, V. H. Syn., Tab. XLI, fig. 9 B.

Loc. Koldewey Isl. (Algæ).

Synedra affinis Kütz., *lancettula* Grun., V. H. Syn., Tab. XLI, fig. 28.

Loc. Off Cape Amélie (Algæ).

Synedra affinis Kütz., *parva* Kütz., V. H. Trt., Tab. X, fig. 432.

Loc. Koldewey Isl. (Algæ).

Synedra affinis Kütz.? *rupicola* Grun., V. H. Syn., Tab. XLI, fig. 27.

Loc. Koldewey Isl. (Algæ, 2 sampl.).

Synedra affinis Kütz., var. *subtilis* Grun., V. H. Syn., Tab. XLI, fig. 18.

Loc. Danmarks Havn (Algæ).

Synedra affinis Kütz., var. *tabulata* Kütz., Perag. Mar. D. d. Fr., Tab. LXXX, figs. 13—14.

Loc. Off Cape Amélie (Algæ, 2 sampl.), Koldewey Isl. (Algæ).

Synedra affinis Kütz. var. *tabulata forma curta acuminata.* V. H. Trt., Tab. X, fig. 431 (Syn. atf. tabul.).

Loc. Off Cape Amélie (Algæ).

Among the numerous scarcely discernable varieties of Synedra affinis only the following are recorded from the Arctic Seas, viz.

Synedra aff. *lanceltula:* W. Greenl.

— - *parva:* W. Greenl., East Arct. S.

— - *tabul. curta acumin.:* Greenl., East Arct. S.

Synedra investiens W. Sm. V. H. Trt., 313, Tab. X, fig. 425.

Loc. Off Cape Amélie (Algæ, 5 sampl.), Danmarks Havn (Algæ), Koldewey Isl. (Algæ).

Arct. Distr. W. Greenl., East Arct. S.

Synedra kamtschatica Grun. Øst. Mar. D. Østg., 450, Tab. VII, fig. 85.

Loc. Off Cape Amélie (Algæ, 3 sampl.), Danmarks Havn (Algæ, 3 sampl.), Koldewey Isl. (Algæ, 3 sampl.), Marg. of the Pack-Ice (2 sampl.).

Arct. Distr. Greenl., East Arct. S.

I have found this species to vary in length from 160 μ to 260 μ.

Fragilaria Lyngb., 1819.

Fragilaria Cylindrus Grun. Grun. Fz. Js. Ld., 55, Tab. II, fig. 13.

Loc. Marg. of the Pack-Ice (2 sampl.).

Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Fragilaria islandica Grun., var. *hyperborea* Cl., Cl. Vega Exp., 484. Tab. nost XIII, fig. 25.

Long. 66 μ. Lat. 7 μ. Str. 11 in 10 μ.

Valva lineare-lanceolata. Striis media in parte valvæ deficientibus, ceterum axin apicalem non attingentibus itaqve aream apicalem magnam relinqventibus.

Loc. Marg. of the Pack-Ice (2 sampl.).

Arct. Distr. According to Cleve: "Greenl., Bessel's Bay."

This species must undoubtedly be Cleve's *Frag. isl. hyp.* about which he says (l. c.): "Area longer, striæ 12 in 0,01 mm."

Fragilaria striatula Lyngb. V. H. Trt., 324, Tab. XXX, fig. 841.

Loc. Koldewey Isl. (3 sampl.).

Arct. Distr. W. Greenl., East Arct. S.

Plagiogramma Grev., 1859.

Plagiogramma Gregorianum. Grev., V. H. Trt., 338, Tab. X, fig. 390.

Loc. Koldewey Isl. (Algæ, 2 sampl.).
Arct. Distr. W. Greenl., East Arct. S.

Licmophora Ag., 1827.

Licmophora gracilis (Ehr.) Grun., V. H. Trt. 343, Tab. XXXI, fig. 851.

Loc. Off Cape Amélie (Algæ), Koldewey Isl. (Algæ, 3 sampl.).
Arct. Distr. W. Greenl.

Licmophora paradoxa (Lyngb.) Ag., V. H. Trt. 344, Tab. XXXI, fig. 855.

Loc. Off Cape Amélie (Algæ), Off Cape Bismarck (Algæ), Koldewey Isl. (Algæ, 3 sampl.).
Arct. Distr. Greenl.

Grammatophora Ehr., 1839.

Grammatophora arctica Cl., Cl. Diat. f. Spb. 664; V. H. Syn., Tab. LIII bis, fig. 3.

Loc. Off Cape Amélie (Algæ), Danmarks Havn (Algæ), Koldewey Isl. (Algæ, 2 sampl.).
Arct. Distr. Greenl., E. of Greenl., East Arct. S.

Grammatophora islandica Grun., Østerr. Diat. I, 418., V. H. Syn., Tab. LIII, fig. 7.

Loc. Danmarks Havn (Algæ), off Cape Bismarck (Algæ), Koldewey Isl. (Algæ, 3 sampl.).
Arct. Distr. Greenl., East Arct. S.

Rhabdonema Kütz., 1844.

Rhabdonema arcuatum (Ag.) Kütz., V. H. Trt. 360, Tab. XII, fig. 487 a.

Loc. Off Cape Amélie (Algæ, 3 sampl.), Danmarks Havn (Algæ), Koldewey Isl. (Algæ, 2 sampl.)
Arct. Distr. Greenl., E. of Greenl., East Arct. S.

Rhabdonema minutum Kütz., V. H. Trt. 361, Tab. XII, fig. 488 a.

Loc. Off Cape Amélie (Algæ), Danmarks Havn (Algæ), Off Cape Bismarck (Algæ) Koldewey Isl. (Algæ, 4 sampl.)
Arct. Distr. Greenl., East Arct. S.

Centricæ.

Rhizosolenia (Ehr. Brigtw.), Peragallo, 1892.

Rhizosolenia hebetata Bait. *forma semispina* (Hensen) Gran, Gran. Nord. Plankt., 55, fig. 67 b.

Loc. Marg. of the Pack-Ice.
Arct. Distr. East Arct. S.

Chætoceros Ehr., 1844.

Chætoceros Diadema (Ehr.) Gran, Gran. Nord. Plankt., 84, fig. 102 b.

Loc. Koldewey Isl. (Algæ, 3 sampl.), Marg. of the Pack-Ice.
Arct. Dist. W. Greenl., East Arct. S.
Only spores found.

Chætoceros septentrionale Øst., Øst. Mar. D. Østg., 457, Tab. VII, fig. 88.

Loc. Off Cape Amélie (Algæ), Marg. of the Pack-Ice.
Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Chætoceros sociale Laud., Gran. Nord. Plankt., 96, fig. 123.

Loc. Koldewey Isl. (Algæ).
Arct. Distr. Sea W. of Greenl., East Arct. S.
Only spores found.

Stephanopyxis Ehr., 1844.

Stephanopyxis Turris (Grev., Ralfs) Grun. var. *Cylindrus* Grun. *forma inermis.* Grun., Fz. Js. Ld. 35, Tab. V, figs. 10—13.

Loc. Koldewey Isl. (Algæ).
Arct. Distr. Franz-Josef Land.

Thalassiosira Cl., 1872.

Thalassiosira decipiens (Grun.) Gran, Gran. nord. Plankt. 17, fig. 10.

Loc. Off Germ. L. (Land-Ice), Marg. of the Pack-Ice.
Not before recorded from Arctic Seas. Several other records.

Thalassiosira gravida Cl., Gran. Nord. Plankt., 18, fig. 12.

Loc: Off Germ. L. (Land-Ice), Marg. of the Pack-Ice.
Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Thalassiosira Nordenskiöldii Cl., Gran. Nord. Plankt., 16, fig. 9.

Loc. Off Germ. L. (Land-Ice), Marg. of the Pack-Ice.
Arct. Distr. Greenl., E. of Greenl., East Arct. S.

Melosira Ag., 1824.

Melosira Jürgensii Ag., V. H. Trt. 442, Tab. XVIII, fig. 612.

Loc. Off Cape Amélie (Algæ).
Hitherto recorded only from the northern coasts of Europe.

Melosira (mediterranea Grun. var?) **gelida** Cl., Cl. Vega Exp., 490, Tab. XXXVIII, fig. 83.

Loc. Off Cape Amélie (Algæ), Koldewey Isl. (Algæ, 4 sampl.).
Arct. Distr. According to Cleve (l. c.) "Mushroom Point."

Melosira hyperborea (Grun.) Gran, Gran. Fr. N. Exp., 52, V. H. Syn., Tab. LXXXV, figs. 3—4.

Loc. Koldewey Isl. (Algæ), Pack-Ice, Marg. of the Pack-Ice (3 sampl.).
Arct. Distr. Greenl., E. of Greenl., East Arct. S.

Podosira Ehr.

Podosira hormoides Mont., Grun. Kasp. S. 130; V. H. Syn., Tab. LXXXIV, fig. 3.

Loc. Off Cape Amélie (Algæ, 3 sampl.), Danmarks Havn (Algæ), Off Cape Bismarck (Algæ), Koldewey Isl. (Algæ, 2 sampl.).

Arct. Distr. Greenl., E. of Greenl.

Podosira hormoides Mont., var.? *minima* Grun., V. H. l. c. figs. 7—8.

Loc. Off Cape Amélie (Algæ), Off Cape Bismarck (Algæ), Koldewey Isl. (Algæ).

According to Grunow (in the explanation of the Tab., quoted above, of V. H. Syn.) "accompagnement le *Podos. hormoides.*"

Podosira Montagnei Kütz., Grun. Kasp., S. 129, V. H. Syn., Tab. LXXXIV, figs. 11—12.

Loc. Off Cape Amélie (Algæ, 3 sampl.), Danmarks Havn (Algæ), Off Cape Bismarck (Algæ), Koldewey Isl. (Algæ. 2 sampl.).

Arct. Distr. Not before recorded from Arctic Seas. Several other records.

Hyalodiscus Ehr., 1854.

Hyalodiscus scoticus (Kütz.) Grun., Cl. & Grun. A. D. 116, V. H. Syn., Tab. LXXXIV, figs. 15—17.

Loc. Danmarks Havn (Algæ), Koldewey Isl. (Algæ, 3 sampl.).

Arct. Distr. Greenl., E. of Greenl., East Arct. S.

Hyalodiscus subtilis Baill. Cl. & Grun. A. D. 116; Perag. D. mar. d. Fr., Tab. CXIX, fig. 7.

Loc. Off Cape Amélie (Algæ, 2 sampl.), Danmarks Havn (Algæ, 2 sampl.), Off Cape Bismarck (Algæ), Koldewey Isl. (Algæ, 4 sampl.).

Arct. Distr. Greenl., East Arct. S.

Biddulphia Gray., 1831.

Biddulphia arctica (Brightw.) Boyer, Brightw. Micr. Journ. IV, 250, Tab. IV, fig. 11 (Triceratium arcticum).

Loc. Danmarks Havn (Algæ, 2 sampl.), Off Cape Bismarck (Algæ), Koldewey Isl. (Algæ, 4 sampl.).

Arct. Distr. Greenl., East Arct. S.

Biddulphia arctica *forma Balæna* Ehr., A. S. Atl., Tab. CXXI, figs. 5—6.

Loc. Off Cape Bismarck (Algæ), Koldewey Isl. (Algæ, 4 sampl.).

Arct. Distr. Greenl., East Arct. S.

Biddulphia aurita (Lyngb.) Bréb., V. H. Trt. 471, Tab. XX, fig. 631.

Loc. Koldewey Isl. (Algæ, 2 sampl.).

Arct. Distr. Greenl., E. of Greenl., East Arct. S.

Biddulphia suborbicularis Grun. var. *arctica* Øst., Øst. Kyst. D. f. Grønl., 343, Tab. II, fig. 14 (Bidd. suborb. var.).

Loc. Koldewey Isl. (Algæ, 4 sampl.).
Arct. Distr. Greenl.

Biddulphia sp., Tab. nostr. XIII, fig. 23.

Striis 11 in 10 μ, punctatis.

Valva biddulphoidea, cornubus satis brevibus, obtusis. Facie connectivali ad apicem leniter triundulata spinamqve singulam longam ostendente.

As I have only seen the valve in zone-view I cannot give this form as a new species.

Actinocyclus Ehr., 1840.

Actinocyclus alienus Grun. var. *arcticus* Grun., Cl. Baff. B. 18, Tab. II, figs. 11—12.

Loc. Marg. of the Pack-Ice.
Arct. Distr. Davis Strait, East Arct. S.

Coscinodiscus Ehr., 1838.

Coscinodiscus concinnus W Sm., V. H. Trt. 531 (Cosc. radiatus var. conc.), Perag. D. mar. d. Fr., Tab. LXV, fig. 12.

Loc. Koldewey Isl. (Algæ).
Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Coscinodiscus radiatus Ehr., V. H. Trt. 530.; Perag. D. mar. d. Fr., Tab. CXVII, fig. 3.

Loc. Off Cape Amélie (Algæ), Koldewey Isl. (Algæ), Marg. of the Pack-Ice.
Arct. Distr. Greenl., E. of Greenl., East Arct. S.

Coscinodiscus subtilis Ehr. var.? *glacialis* Grun., Grun. Fz. Js. Ld. 56, Tab. III, fig. 27.

Loc. Marg. of the Pack-Ice.
Arct. Distr. Mouth of Yennissey (According to Grunow l. c.).

Coscinodiscus (**lacustris** Grun. var.?) **septentrionalis** Grun., Grun. Fz. Js. Ld., 33, Tab. IV, fig. 33.

Loc. Marg. of the Ice.
Arct. Distr. W. Greenl., E. of Greenl., East Arct. S.

Distribution of the Marine Diatoms.

		W. Gr.	E. Gr.	E. of Gr.	E. A. S.
	Achnanthes				
1	— brevipes	x	x	..	x
2	— — *intermedia*	..	x	..	x
3	— — *elliptica*	..	x	..	..
4	— — *parvula*	x	x	..	..
5	— groenlandica	x	x	..	x
6	— hyperborea	..	..	..	x
	Actinocyclus				
7	— alienus *arcticus*	x	..	..	x
	Amphipleura				
8	— rutilans	x	x	..	..
9	— — *antarctica*	..	..	..	..
	Amphiprora				
10	— gigantea *sept.*	x	x	..	x
11	— Kjellm. *glacial.*	..	x	..	x
	Amphora				
12	— acutiuscula	x	..	..	x
13	— angusta	x	..	..	x
14	— costata	..	x	..	..
15	— crassa	x	x	..	x
16	— Eunotia	x	x	..	x
17	— granulata	..	..	..	..
18	— lævis lævissima	..	..	x	x
19	— lineolata	..	..	..	x
20	— macilenta	..	..	..	..
21	— margaritifera	x	..	..	..
22	— marina	..	x	x	..
23	— Proteus	x	x	..	x
24	— — *contigua*	..	x	..	..
25	— Terroris	x	x	..	x
26	— — *inflata*	..	x	..	..
	Auricula				
27	— minuta	..	..	..	..
	Biddulphia				
28	— arctica	x	x	..	x
29	— — *Balæna*	x	x	..	x
30	— aurita	x	x	x	x
31	— subor bicularis *var.*	x	x	..	..
	Caloneis				
32	— amphisb. *fuscata*	..	..	..	x
		17	20	3	19

		W. Gr.	E. Gr.	E. of Gr.	E. A. S.
33	(Caloneis) brevis	x	..	..	x
34	— kryophila	x	x	..	x
	Campylodiscus				
35	— angularis	x	x	..	x
	Chætoceros				
36	— Diadema	x	..	..	x
37	— septentrionale	x	..	x	x
38	— sociale	x	..	..	x
	Cocconeis				
39	— costata	x	x	..	x
40	— — *pacifica*	x	x	..	..
41	— dirupta *decipiens*	x	..	..	x
42	— pinnata	..	..	..	x
43	— pseudomarginata	x	x	..	x
44	— Scutellum	x	x	..	x
45	— — *minutissima*	..	..	..	x
46	— — *californica*	..	..	..	x
47	— septentrionalis	..	..	..	x
	Coscinodiscus				
48	— concinnus	x	..	x	x
49	— radiatus	x	x	x	x
50	— septentrionalis	x	..	x	x
51	— subtilis	..	..	..	x
	Diploneis				
52	— borealis	x	..	x	x
53	— coffæiformis	..	..	..	..
54	— Entomon	..	x	..	x
55	— interrupta	..	..	x	x
56	— littoralis *arctica*	x	..	x	x
57	— — *hyperborea*	x	..	x	x
58	— muscæformis	..	..	..	..
59	— Smithii	x	x	..	x
60	— splendida	x	x	..	x
61	— subcincta	..	x	..	x
62	— vacillans	..	..	..	..
	Fragilaria				
63	— Cylindrus	x	..	x	x
64	— islandica *hyperb.*	x	..	..	..
65	— striatula	x	..	..	x
	Gomphonema				
66	— exiguum arctic	x	x	..	x
		23	12	9	29

		W. Gr.	E. Gr.	E. of Gr.	E. A. S.
67	(Gonophonema) groenland.	x	..	x	x
68	— kamschaticum ...	x	..	x	x
69	— septentrionale ...	..	..	x	..
70	— — *angustum*	..	..	x	..
	Grammatophora				
71	— arctica	x	x	x	x
72	— islandica	x	x	..	x
	Gyrosigma				
73	— arcticum	x	..	..	x
	Hantschia				
74	— Weyprechtii	..	..	x	x
	Hyalodiscus				
75	— scoticus	x	x	x	x
76	— subtilis.....	x	x	..	x
	Liemophora				
77	— gracilis.....	x	..	..	..
78	— paradoxa	x	x	..	..
	Melosira				
79	— hyperborea	x	x	x	x
80	— Jürgensii	..	..	..	..
81	— mediterr. *gelida*..	x	..	..	..
	Navicula				
82	— ammophila	..	..	..	x
83	— Baculus	..	..	x	x
84	— bahusiensis.....	..	..	x	x
85	— Bolleana.....	x	..	..	x
86	— — *intermedia*	..	..	x	..
87	— cancellata	x	x	..	x
88	— — *Gregorii* ...	..	..	x	x
89	— — *retusa*.....	..	..	..	x
90	— — *subapicul.* .	x	..	..	x
91	— digitoradiata.....	x	x	x	x
92	— — *Cyprinus* ..	x	x	..	..
93	— directa *genuina*..	x	x	..	x
94	— — *cuneata* ...	..	..	x	..
95	— — *lata*.....	..	..	x	..
96	— — *remota*....	x	x	..	x
97	— distans.....	x	..	x	x
98	— fusif. *ostrearia*...	..	..	..	..
99	— glacialis	x	..	x	x
100	— — *septent.* ...	x	x	..	x
101	— Grevillei.....	x	x	..	x
		22	13	17	24

		W. Gr.	E. Gr.	E. of Gr.	E. A. S.
102	(Navicula) inflexa	..	..	..	x
103	— kariana *detersa* ..	x	..	x	x
104	— — *frigida* ...	x	..	..	x
105	— kryok. *subprot.* ..	..	..	x	x
106	— mollis.....	x	..	..	..
107	— obtusa	x	..	x	x
108	— peregrina	x	..	..	x
109	— — *kefvingensis*	..	..	..	..
110	— punctulata.....	x	x	..	x
111	— pygmæa.....	..	..	..	x
112	— ramosissima	x	x	..	..
113	— rhombica.....	x	..	..	..
114	— rostelloides	..	..	x	..
115	— sibirica	..	..	x	x
116	— spectabilis.....	x	x	..	..
117	— — *densestriata*	..	x	..	..
118	— Spicula.....	..	..	x	x
119	— subinflata	x	..	x	x
120	— superba	x	x	x	x
121	— — *subacuta* ..	..	..	..	x
122	— transitans	x	..	x	x
123	— trigonocephala ...	x	..	x	x
124	— valida.....	..	x	x	x
125	— Wankaremæ	..	..	..	x
126	— vitrea	x	..	x	x
127	— Zostereti	..	..	x	..
	Nitschia				
128	— angularis	x	x	x	x
129	— — *borealis* ...	x	x	..	x
130	— bilobata	x	..	..	..
131	— Brébiss. *borealis* .	x	..	x	x
132	— distans.....	x	..	..	x
133	— hybrida	..	..	x	x
134	— insignis *arctica* ..	..	x	..	x
135	— lanceolata	..	..	x	..
136	— lævissima	..	..	x	x
137	— paradoxa	..	..	..	x
138	— scabra	x	..	x	x
139	— Sigma.....	x	..	..	x
140	— — *Sigmatella*.	..	..	..	..
141	— — *valida*	x	..	..	..
142	— polaris	x	..	x	x
143	— socialis *kasiana*..	..	..	..	x
344	— Trybl. *levidensis*..	..	x	..	x
	Pinnularia				
145	— bistriata.....	..	..	..	..
		23	10	20	31

		W. Gr.	E. Gr.	E. of Gr.	E. A. S.
146	(Pinnularia) qvadratarea.	x	x	x	x
147	— — *constricta* .	..	..	x	x
148	— — *dubia*	..	..	..	x
149	— — *gibbosa*....	..	..	x	x
150	— Stuxbergii	x	..	x	x
	Plagiogramma				
151	— Gregorianum	x	..	..	x
	Pleurosigma				
152	— elongatum... ...	x	x	..	x
	Podosira				
153	— hormoides.....	x	x	x	..
154	— — *minima* ...	..	..	..	..
155	— Montagnei.....	..	..	..	..
	Rhabdonæma				
156	— arcuatum	x	x	x	x
157	— minutum.....	x	x	..	x
	Rhizosolenia				
158	— hebet. *semisp.* ...	..	..	..	x
	Rhoicosphenia				
159	— curvata	x	x	x	x
	Stauroneis				
160	— pellucida *constr.* .	..	..	x	..
161	— perpusilla	..	..	x	x
		8	6	9	12

		W. Gr.	E. Gr.	E. of Gr.	E. A. S.
	Stephanopyxis				
162	— Turris *var.*.....	..	..	..	x
	Surirella				
163	— Oestrupii.....	..	x	x	x
	Synedra				
164	— affinis *genuina*...	..	..	..	..
165	— — *acuminata*.	..	..	..	..
166	— — *fasciculata*.	..	..	..	..
167	— — *hybrida* ...	..	..	..	..
168	— — *lancelettula*	x	..	..	..
169	— — *parva*.....	x	..	..	x
170	— — *rupicola*...	..	..	..	..
171	— — *subtilis*....	..	..	..	..
172	— — *tabulata* ..	..	..	..	..
173	— — *curta acum*	x	x	..	x
174	— investiens	x	..	..	x
175	— kamtschatica	x	x	..	x
	Thalassiosira				
176	— decipiens.....	..	..	..	..
177	— gravida	x	..	x	x
178	— Nordenskiöldii ...	x	x	x	x
	Trachyneis				
179	— asp. *genuina*.....	..	..	..	..
180	— — *vulgaris*	x	..	..	..
181	— — *intermedia* ..	x	x	x	x
	Tropidoneis				
182	— longa	x	x	..	x
		10	6	4	10
	Total...	103	66	62	123

In the above list I have given an account of the distribution of the individual species within different districts of the Arctic Seas.

I have in all 182 marine forms, of which 24 have until now been unrecorded from the Arctic Seas. Hence 158 (86.8 %), therefore by far the greater part, have previously been recorded from these districts. If we now investigate the more detailed distribution, the result will be as follows: —

(1) From W. Greenl. are known ..... 103 (56.6 %)
— E. Greenl. + E. of Greenl. are known 120 (66.0 %)
— East Arct. S. are known ..... 125 (68.7 %)

(2) From W. Greenl. only, and from nowhere else in the Arctic districts ..... 10 (5.5 %)
— E. Greenl. + E. of Greenl. only, and from nowhere else in the Arctic districts.. 15 (8.2 %)
— East Arct. S. only, and from nowhere else in the Arctic districts ..... 19 (10.4 %)

(3) From W. Greenl. + E. Greenl..... 53 (29.1 %)
— W. Greenl. + Eastward ..... 90 (49.5 %)
— Eastward on the whole ..... 149 (81.9 %)

These three percentage tables show, that there is a rise in the percentages as regards the eastern districts, and therefore the Diatoms found in the material at hand indicate an easterly tendency as regards their Arctic distribution.

As the material examined consists partly of Alga-samples, partly of ice-samples, I have in the following table given an account of the occurrence of the genera in these samples.

	Predominant in the Alga-samples are the genera	Number of species and varieties		Predominant in the ice-samples are the genera	Number of species and varieties		In both Alga- and ice-samples occur the genera	Number of species and varieties	In Alga-samp.	In ice-samp.	Both in Alga- and ice-samp.
1	Achnanthes	6	1	Actinocyclus ...	1	1	Caloneis	3	2	1	..
2	Amphipleura...	2	2	Amphiprora ...	2	2	Chætoceros	3	1	..	2
3	Amphora	15	3	Rhizosolenia ...	1	8	Coscinodiscus ..	4	2	2	..
4	Auricula.....	1	4	Stauroneis	2	4	Diploneis	11	9	2	..
5	Biddulphia	4	5	Stephanopyxis .	1	5	Fragilaria.....	3	1	2	..
6	Campylodiseus .	1	6	Thalassiosira...	3	6	Gomphonema ..	5	1	3	1
7	Cocconeis.....	9			10	7	Gyrosigma.....	1	..	..	1
8	Grammatophora	2				8	Hantzschia.....	1	..	..	1
9	Hyalodiscus....	2				9	Melosira.....	3	2	1	..
10	Licmophora....	2				10	Navicula.....	46	25	18	3
11	Plagiogramma..	1				11	Nitzschia	17	14	3	..
12	Pleurosigna	1				12	Pinnularia.....	6	3	3	..
13	Podosira.....	3						103	60	35	8
14	Rhabdonema...	2									
15	Rhoicospenia...	1									
16	Surirella.....	1									
17	Synedra	12									
18	Trachyneis.....	3									
19	Tropidoneis....	1									
		69									

The above table shows that the following is the distribution in the samples of the 37 genera which occur — 19 (51.4 %) in Alga- and ice-samples, 12 (32.4 %) both in Alga- and ice-samples, and 6 (16.2 %) in ice-samples.

With regard to the species and varieties we find the proportions to be as follows: —

In the Alga-samples are found	129	(70.9 %)
In the ice-samples are found	45	(24.7 %)
Both in the Alga- and ice-samples are found	8	(4.4 %)

All the figures were drawn magnified 1000 times by the author, and then photographically reduced to a magnification of 660.

Fig. 1. Navicula rostelloides sp. nova ..... Page 201
— 2. — jamalinensis Cl., var. *subcircularis* var. nova ..... — 206
— 3. Trachyneis aspera (Ehr.), Cl., var. *intermedia* Grun. *forma robusta* .. — 204
— 4. Navicula peregrina Ehr., var.? *oblonga* var. nova ..... — 207
— 5. — jejuna A. Sch., var. *arctica* var nova ..... — 206
— 6. — subcuneata, sp. nova ..... — 207
— 7. — ? gomphonemoides, sp. nova ..... — 208
— 8. — valida, Cl. & Grun. *forma minor* ..... — 208
— 9. — Lyra Ehr., var. *arctica* var. nova ..... — 209
— 10. — scopulorum Bréb., var. *arctica* var. nova ..... — 203
— 11. Amphora gigantea Grun. ..... — 210
— 12. — virgata, sp. nova ..... — 210
— 13. Cocconeis pinnata, Greg., var. *arctica* var. nova ..... — 213
— 14. — ornata, Greg.? ..... — 214
— 15. Achnanthes hyberborea, Grun. ..... — 214
— 16. Amphora venusta, sp. nova ..... — 212
— 17. Cocconeis sp. ..... — 214
— 18. Achnanthes rhombica, sp. nova ..... — 215
— 19. Surirella insignis, sp. nova ..... — 216
— 20. Nitzschia marginulata Grun., var. *genuina* Grun. *forma minuta*? ... — 217
— 21. Achnanthes septentrionalis, sp. nova ..... — 215
— 22. — — var. *subcapitata* var. nova ..... — 215
— 23. Biddulphia sp. ..... — 224
— 24. Achnanthes debilissima, sp. nova? ..... — 214
— 25. Fragilaria islandica Grun., var. *hyperborea* Cl. ..... — 220
— 26. Nitzschia Sigma, W. Sm., var. *robusta* var. nova ..... — 218

FRESHWATER-DIATOMS.

PENNATÆ.

Diraphideæ.

Caloneis Cl., 1894.

Caloneis Clevei (Lgst.) Cl., Cl. Syn., I, 51; Lgst., Spb., Tab. I, fig. 10 (Nav. Clevei).

Loc. Vester Elv.

Arct. Distr. E. Greenl., Spb., J. M.

Caloneis fasciata (Lgst.) Cl., Cl. Syn., I, 50; V. H. Syn., Tab. XII, fig. 34 (Nav. fasciata).

Loc. Off Cape Amélie (Algæ), Danmarks Havn (Algæ).

Arct. Distr. Spb., J. M.

In a sample from Thermometerfjeld I found a form agreeing with *Navicula fonticola* Grun (V H. Syn., Tab. XII, fig. 32) which Cleve (l. c.) refers to *Caloneis fasciata*.

Caloneis lepidula (Grun.) Cl., Cl. Syn., I, 50; V. H. Trt., Tab. V, fig. 236 (Nav. lepid.).

Loc. Vester Elv.

Not before recorded from Arctic regions.

Caloneis septentrionalis sp. nova. Tab. nost. XIV, fig. 1.

Long. 70 μ. Lat. 8 μ. Str. 14 in 10 μ, delicatissime punctatis.

Valva lineari, apicibus rotundatis. Raphe area satis lata hyalina cincta. Striis parallelis, sub apices convergentibus media in valva deficientibus ibiqve fasciam transapicalem angustam relinqventibus. Linea inframarginali difficulter perspicienda. Nodulis terminalibus figuram sicut flammulæ præbentibus.

Loc. Hvalrosodde, Vester Elv.

Possibly this species, in spite of its coarse striation, may be most nearly allied to the group belonging to *Caloneis fasciata*.

Caloneis Silicula (Ehr.) Cl. var. *alpina* Cl., Cl. Syn., I, 51; Lgst., Spb., Tab. I, fig. 6 (Nav. limosa).

Loc. Hvalrosodde, Vester Elv (2 sampl.).

Arct. Distr. E. Greenl., Spb., J. M.

Caloneis Silicula var. *ventricosa* (Ehr.) Donk., Cl. Syn., I, 52; V. H. Trt., Tab. V, fig. 209 (Nav. ventric.).

Loc. Vester Elv.
Arct. Distr. Fz. Js. Ld.

Neidium Pfitz., 1871.

Neidium affine Ehr. var. *genuina* Cl. *forma minor*, Cl. Syn., I, 68; Lgst., Spb., Tab. I, fig. 9 (Nav. bisulcata turgidula).

Loc. Vester Elv.
Arct. Distr. Spb.

Neidium affine Ehr. var *longiceps* Greg., Greg. M. J., IV, Tab. I, fig. 27 (Nav. longic.).

Loc. Vester Elv.
Arct. Distr. W. Greenl.

Neidium bisulcatum Lgst., Cl. Syn., I, 68; Lgst., Spb., Tab. I, fig. 18 (Nav. bisulc.).

Loc. Vester Elv.
Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld., Spb., J. M.

Neidium decoratum Brun, Brun, Jan M. & Est-Groenl., 18, Tab. II, figs. 6—7.

Loc. Hvalrosodde, Vester Elv (2 sampl.).
Arct. Distr. E. Greenl.

Neidium Iridis (Ehr.) Cl., Cl. Syn., I, 69; V. H. Trt., Tab. V, fig. 212 (Nav. Ir.).

Loc. Hvalrosodde.
Arct. Distr. E. Greenl., Fz. Js. Ld.

Diploneis Ehr., 1840.

Diploneis oculata (Bréb.) Cl., Cl. Syn., I, 92; V. H. Syn., Tab IX, fig. 10 (Nav. ocul.).

Loc. Off Cape Amélie (Algæ).
Not before recorded from Arctic regions. Other record, France.

Diploneis Puella (Schum?) Cl., Cl. Syn., I, 92; V. H. Trt., Tab. IV, fig. 158 (Nav. ellipt. minima).

Loc. Off Cape Amélie (Algæ).
Arct. Distr. W. Greenl., Spb.

Frustulia Ag., 1824.

Frustulia rhomboides Ehr. var. *leptocephala* Øst., Øst. Ferskv. D. f. Østg., 257, Tab. I, fig. 1.

Loc. Vester Elv (2 sampl.).
Arct. Distr. E. Greenl.

Naviculæ merolejæ Cl., 1894.

Navicula bacilliformis Grun, Cl. Syn., I, 131; V. H. Trt., Tab. XXVII, fig. 774.

Loc. Nostoc.
Not before recorded from Arctic regions. Several other records.

Navicula Heufleriana Grun., Cl. Syn., I, 130; V. H. Syn., Tab. IV, fig. 1 a.

Loc. Hvalrosodde.
Arct. Distr. Fz. Js. Ld.

Navicula mutica Kütz. *forma Cohnii Hilse*, Cl. Syn., I, 129; V. H. Trt., Tab. 4, fig. 167 (Nav. mut.).

Loc. Lille Snenæs, Danmarks Havn, Vester Elv.
Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld., Spb., J. M.

Navicula mutica *forma Gøppertiana* Bleisch, V. H. Syn., Tab. X, figs. 18—19.

Loc. Off Cape Amélie (Algæ, 2 sampl.).
Not before recorded from Arctic regions. Several other records.

Navicula mutica *forma ventricosa* Kütz., V. H. Trt., Tab. IV, fig. 171 (Nav. ventric.).

Loc. Lille Snenæs (2 sampl.), Vester-Elv, Thermometerfjeld.
Arct. Distr. E. Greenl., Fz. Js. Ld., J. M.

Navicula nivalis Ehr., Cl. Syn., Tab. I, 130; V. H. Syn., Tab. X, fig. 21 (Nav. qvinqvenodis Grun.).

Loc. Thermometerfjeld.
Arct. Distr. Fz. Js. Ld.

Navicula Rotæana Rabh., Cl. Syn., I, 128; Lgst., Spb., Tab. I, fig. 13 (Stauroneis minutissima).

Loc. Lille Snenæs.
Arct. Distr. E. Greenl., Spb., B. El., J. M.

Navicula Seminulum Grun., Cl. Syn., I, 128; V. H. Trt., Tab. V, fig. 228.

Loc. Thermometerfjeld.
Arct. Distr. W. Greenl., Spb.

Naviculæ entolejæ Cl., 1884.

Navicula contenta Grun., Cl. Syn., I, 132; V. H. Trt., Tab. V, fig. 239.

Loc. Dove Bugt, Vester Elv.
Arct. Distr. E. Greenl.

Naviculæ decipientes Grun., 1880.

Navicula gibbula Cl., Cl. Syn., I, 140; Lgst., Spb., Tab. I, fig. 7 a (Nav. gibberula).

Loc. Hvalrosodde, Lille Snenæs (2 sampl.), Vester Elv (2 sampl.), Thermometerfjeld.

Arct. Distr. E. Greenl., Fz. Js. Ld., Spb., J. M.

Navicula gibbula var. *capitata* Lgst., Lgst. l. c., fig. 7 a[1], Tab. nost. XIV, fig. 2.

Loc. Hvalrosodde, Nostoc.

Arct. Distr. E. Greenl., Spb.

This form, of which I have given a figure, differs in the striation, which in the main species is radiate, but here is radiate only in the middle and parallel towards the apices. Lagerstedt has not shown the striation in his fig. 7 a[1], but with regard to the outline and general appearance his figure agrees very well with the present form. Therefore I have no doubt that the present form is identical with *Nav. gibb. capitata* Lgst.

Navicula Lagerstedtii Cl., Cl. Syn., I, 141; Lgst., Spb., Tab. II, fig. 12 (Navicula sp.).

Loc. Hvalrosodde.

Arct. Distr. E. Greenl., Spb.

Naviculæ microstigmaticæ Cl., 1894.

Stauroneis anceps Ehr., Cl. Syn., I, 147; V. H. Trt., Tab. I, figs. 55—57 (including also St. anc. linearis and St. anc. amphicephala).

Loc. Hvalrosodde, Dove Bugt, Lille Snenæs, Vester Elv (3 samples).

Arct. Distr. W. Greenl., E. Greenl., Spb., J. M.

Stauroneis dilatata Ehr. *forma minor* Tab. nost XIV, fig. 3.

Long. 37 μ. Lat. 8 μ. Striis subtilissimis.

Valva elliptice-lanceolata, apicibus capitatis. Raphe area hyalina, mediam valvam versus patescente, cincta. Stauro lato margines non attingente. Striis radiantibus. Nodulis terminalibus inconspicuis.

Loc. Off Cape Amélie (Algæ).

Arct. Distr. The main species: Europe, Siberia.

Stauroneis javanica Grun., var. *oblonga* Øst., Øst., Ferskv. D. f. Østgr., 260, Tab. I, fig. 4.

Loc. Hvalrosodde (2 sampl.), Lille Snenæs.

Arct. Distr. E. Greenl.

Stauroneis javanica Grun., var. *truncata* Øst., Øst. l. c. fig. 5.

Loc. Stormkap, Vester Elv.

Arct. Distr. E. Greenl.

Stauroneis obtusa Lgst., Cl. Syn., I, 149; Lgst., Spb., Tab. I, fig. 11.

Loc. Hvalrosodde.

Arct. Distr. Fz. Js. Ld., Spb.

Stauroneis parvula Grun., Cl. Syn., I, 149; O. Müll., Riesengeb., Tab. III, fig. 33.

Loc. Hvalrosodde, Lille Snenæs.

Not before recorded from Arctic regions. Other record, Europe.

Stauroneis Phoenicenteron Ehr., var. *amphilepta* Ehr., Cl. Syn., I, 149; Herib., Diat. d'Auv., Tab. III, fig. 18.

Loc. Hvalrosodde, Vester Elv (2 sampl.).
Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld.
In a sample from Lille Snenæs I found a Stauroneis which corresponds very well with the form in my "Danske Diatoméer," Tab. II, fig. 36, which I consider intermediate between *Staur. anceps* and *Staur. Phyllodes* Ehr.

Cymbella Ag., 1830.

Cymbella æqvalis W. Sm., Cl. Syn., I, 170; V. H. Syn., Tab. III, fig. 1 a.

Loc. Hvalrosodde (2 sampl.).
Arct. Distr. W. Greenl., E. Greenl.

Cymbella affinis Kütz., var. *tumida* Lgst., Cl. Syn., I, 171 (ad Cymb. aff.?). Lgst., Spb., 43, Tab. II, fig. 19.

Loc. Hvalrosodde (2 sampl.), Nostoc.
Arct. Distr. E. Greenl., Spb.

Cymbella angustata W. Sm., Cl. Syn, I, 161; W. Sm., Syn., Tab. XVII, fig. 156; Lgst., Spb., Tab. II, fig. 10 (Nav. inæqvilatera).

Loc. Hvalrosodde (2 sampl.), Vester Elv.
Art. Distr. W. Greenl., E. Greenl., Spb.

Cymbella Botellus Lgst., Cl. Syn., I, 172; Lgst., Spb., Tab. II, fig. 22 (Cymb. variabilis var. Bot.).

Loc. Hvalrosodde.
Arct. Distr. E. Greenl., Spb.

Cymbella Cesatii Rabh., Cl. Syn., I, 160; V. H. Trt., Tab. III, fig. 143 (Nav. Ces.).

Loc. Hvalrosodde.
Arct. Distr. W. Greenl., E. Greenl.

Cymbella gracilis Rabh., Cl. Syn., I, 169; V. H. Trt., Tab. XXVIII, fig. 791 bis, c (Encyonema lunatum).

Loc. Hvalrosodde.
Arct. Distr. W. Greenl., E. Greenl., Spb.

Cymbella hebridica Grun., Cl. Syn., I, 169; Cl., Diat. Finl., Tab. II, figs. 16—17 (Encyonema hebr.).

Loc. Hvalrosodde.
Not before recorded from Arctic regions. Several other records.

Cymbella heteropleura Ehr. var. *minor* Cl., Cl. Syn., I, 167; Lgst., Spb., Tab. II, fig. 17 (Cymb. Ehrenb. var.).

Loc. Hvalrosodde (4 sampl.), Vester Elv.
Arct. Distr. E. Greenl., Fz. Js. Ld., Spb.

Cymbella leptoceros Ehr., Cl. Syn., I, 162; V H. Syn., Tab. II, fig. 18.

Loc. Hvalrosodde, Vester Elv.
Not before recorded from Arctic regions. Several other records.

Cymbella naviculiformis Auersw., Cl. Syn., I, 166; Lgst., Spb., Tab. II, fig. 18 (Cymb. anglica).

Loc. Hvalrosodde.
Arct. Distr. W. Greenl., E. Greenl., Spb., B. El.

Cymbella septentrionalis sp. nova. Tab. nost. XIV, fig. 4.

Long. 32—56 μ. Lat. 7—8 μ. Str. 14 in 10 μ, delicatissime transverse lineatis.

Valva fere cymbiformi, apicibus marginem dorsalem versus paululum recurvatis. Margine ventrali subundulata. Raphe leniter arcuata, area hyalina distincta, media in valva in aream centralem longinam dilatata, cincta. Nodulis terminalibus marginem dorsalem versus recurvatis.

Loc. Hvalrosodde (2 sampl.).
Very nearly linear specimens of this species sometimes occur.

Cymbella sinuata Greg., Cl. Syn., I, 170; V. H. Trt., Tab. XXV, fig. 699 (Cymb. abnormis).

Loc. Hvalrosodde.
Not before recorded from Arctic regions. Several other records.

Cymbella stauroneiformis Lgst., Cl. Syn., I, 165; Lgst., Spb., Tab. I, fig. 15.

Loc. Hvalrosodde (2 sampl.), Vester Elv.
Arct. Distr. E. Greenl., Fz. Js. Ld., Spb.

Cymbella ventricosa Kütz., Cl. Syn., I, 168; V. H. Syn., Tab. III, fig. 15 (second fig. Encyon. ventr.).

Loc. Vester Elv.
Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld., Spb.

Cymbella ventricosa var. *ovata* Grun., V. H. Trt., Tab. I, fig. 48 (Encyon. cæspit. lata).

Loc. Vester Elv.
Not before recorded from Arctic regions. Several other records.

Cymbella ventricosa var. *semicircularis* Lgst., Lgst., Spb., Tab. II, fig. 20 (Cymb. affinis semicirc.).

Loc. Dove Bugt.
Arct. Distr. E. Greenl., Spb.

This variety, which Cleve (Syn. I, 168) places under *Cymb. ventricosa* seems to be so peculiar in appearance that it certainly may be considered a distinct variety.

In a sample labelled "Nostoc" I found a Cymbella, which is figured in V. H., Syn., Tab. III, fig. 18 as a "Forme moyenne entre *l'Encyonema cæspitosum* et *l'Encyonema Lunula*."

Gomphonema Ag., 1824.

Gomphonema boreale sp. nova. Tab. nost. II, fig. 5.

Long. 60 μ. Lat. 5,5 μ. Str. 8 in 10 μ, punctatis; punct. 10—11 in 10 μ.

Valva clavata, apicibus rotundatis. Raphe area hyalina satis lata cincta. Striis subradiantibus, media in valva deficientibus ibiqve fasciam transapicalem latam relinqventibus. Nodulis terminalibus inconspicuis. Punctum unilaterale non perspicere potui.

Loc. Off Cape Amélie (Algæ). Only a single specimen met with.

Judging from its appearance as a whole this form may be a freshwater-species, although it occurred in a sample of marine Algæ.

Naviculæ minusculæ Cl., 1895.

Navicula Atomus Nægeli var. *circularis* Øst., Øst., Kossog., 84, Tab. I, fig. 10.

Loc. Vester Elv.

Not before recorded from Arctic regions. Other record, Kossogol.

Navicula lucidula Grun., Cl. Syn., II, 4; V. H. Syn., Tab. XIV, fig. 40.

Loc. Hvalrosodde.

Not before recorded from Arctic regions. Other records, Denmark, Kossogol.

Anomoeoneis Pfitz., 1871.

Anomoeoneis exilis (Kütz.), Grun., Cl. Syn., II, 8; V. H. Trt., Tab. IV, fig. 198 (Nav. exil.).

Loc. Hvalrosodde.

Arct. Distr. W. Greenl., E. Greenl.

Anomoeoneis Zellensis Grun., Cl. Syn., II, 7; V. H. Syn., Tab. XII, fig. 14 (Nav. Zell.).

Loc. Hvalrosodde.

Arct. Distr. W. Greenl., E. Greenl.

Anomoeoneis Zellensis var. *linearis* Øst., var. nova. Tab. XIV, fig. 6.

Long. 22 μ. Lat. 4 μ. Striis inconspicuis.

Valva lineari, apicibus leniter attenuatis. Raphe area hyalina angusta media in valva in aream transapicalem parvam rotundatam dilatata, cincta. Structura valvæ sicut scabrosa, an elevationes apicales laterales ostendente? Nodulis terminalibus inconspicuis.

Loc. Hvalrosodde (2 sampl.).

This small form recalls in its structure that of *Anomoeon. Zell.*, but in outline it recalls *Navicula difficilis* Grun. (V. H. Syn., Tab. XII, fig. 17) a species which perhaps may belong to the genus *Anomoeoneis*.

Naviculæ heterostichæ Cl., 1895.

Navicula cocconeiformis Greg., Cl. Syn., II, 9; V. H. Trt., Tab. XXVII, fig. 779.

Loc. Vester Elv (5 sampl.).
Arct. Distr. W. Greenl., E. Greenl., Spb., B. El., J. M.

Naviculæ lineolatæ Cl., 1895.

Navicula anglica Ralfs., Cl. Syn., II, 22; V. H. Trt., Tab. III, fig. 136.

Loc. Danmarks Havn (Algæ).
Not before recorded from Arctic regions. Several other records.

Navicula anglica Ralfs *forma elongata.* Tab. nost. XIV, fig. 7. Long. 28 μ. Lat. 8 μ. Str. 11 in 10 μ, transverse lineatis.

Valva elliptica, apicibus rostratis. Raphe area hyalina, mediam valvam versus gradatim patescente, cincta. Striis radiantibus, media in valva alternatim longis abbreviatisqve. Nodulis terminalibus inconspicuis.

Loc. Koldewey Isl. (Algæ).
This form may be considered a somewhat narrow *Nav. anglica.*

Navicula capitata Cl., Cl. Diat. f. Fz. Js. Ld., 5, fig. 2.

Loc. Vester Elv,
Arct. Distr. Fz. Js. Ld.

Navicula cincta Ehr., Cl. Syn., II, 16; V. H. Trt., Tab. III, fig. 105.

Loc. Off Cape Amélie (Algæ).
Arct. Distr. Fz. Js. Ld.

Navicula dicephala (Ehr.?) W. Sm., Cl. Syn., II, 21; V. H. Trt., Tab. III, fig. 138.

Loc. Hvalrosodde (2 sampl.), Vester Elv.
Arct. Distr. J. M.

Navicula falaisensis Grun., Cl. Syn., II, 21; V. H. Trt, Tab. V, fig. 232.

Loc. Off Cape Amélie (Algæ), Vester Elv.
Arct. Distr. W. Greenl.

Navicula Gastrum Ehr., Cl. Syn., II, 22; V. H. Trt., Tab. III, fig. 134.

Loc. Off Germ. L. (Land-Ice), Marg. of the Pack-Ice.
Arct. Distr. W. Greenl., E. of Greenl.

Navicula gracilis Ehr. var. *obesa* var. nova. Tab. nost XIV, fig. 8. Long. 33 μ. Lat. 9 μ. Str. 11 in 10 μ transverse lineatis.

Valva elongate-elliptica apicibus rotundatis. Raphe area angusta hyalina, media in valva in aream transapicalem dilatata, cincta.

Striis radiantibus, sub apices leniter convergentibus, media in valva spatiatis.

Loc. Dove Bugt.

I think this form may be a variety of *Nav. gracilis*, perhaps most nearly allied to *Nav. grac.* var. *schizonemoides* figured in V. H. Syn., Tab. XV, fig. 37 (the second figure).

Navicula lanceolata (Ag.?) Kütz, Cl. Syn., II, 21; V. H. Trt., Tab. III, fig. 139.

Loc. Off Cape Amélie (Algæ), Hvalrosodde, Vester Elv.

Not before recorded from Arctic regions. Several other records.

Navicula lanceolata var. *tenella* A. S., A. S. Atl., Tab. XLVII, figs. 45—46.

Loc. Off Cape Amélie (Algæ), Danmarks Havn (Algæ).

Not before recorded from Arctic regions. Other records, Sweden, Loka (Cl. l. c.).

Navicula Placentula Ehr., Cl. Syn., II, 23; V. H. Trt., Tab. III, fig. 135 (Nav. Gastrum Placentul.).

Loc. Off Cape Amélie (Algæ), Marg. of the Pack-Ice (2 sampl.).

Arct. Distr. Yenissey.

Navicula radiosa Kütz., Cl. Syn., II, 17; V. H. Trt., Tab. III, fig. 112.

Loc. Hvalrosodde.

Arct. Distr. W. Greenl., E. Greenl., Spb., B. El.

Navicula rhyncocephala Kütz., Cl. Syn., II, 15; V. H. Trt., Tab. III, fig. 119.

Loc. Off Cape Amélie (Algæ, 2 sampl.).

Arct. Distr. B. El.

Navicula viridula Kütz. var. *slesvicensis* Grun., Cl. Syn., II, 15; V. H. Trt., Tab. III, fig. 118.

Loc. Dove Bugt.

Arct. Distr. W. Greenl., E. Greenl.

Navicula sp. Tab. nost XIV, fig. 9.

Long. 21 μ. Lat. 5,4 μ. Striis inconspicuis.

Valva lanceolata apicibus capitatis. Raphe distincta.

Loc. Dove Bugt.

This small form shows only very few, if any, distinct characters. I think I have seen indications of a striation which, at least in the middle of the valve, seemed to me to be radiate, but I am not quite certain; therefore I do not feel justified in recording it as a new species.

Naviculæ punctatæ Cl., 1895.

Navicula pusilla W. Sm. var. *capitata* var. nova. Tab. nost. XIV, fig. 10.

Long. 45 μ. Lat. 22 μ. Str. 10—11 in 10 μ, sub apices densioribus, distincte punctatis.

Valva sub-orbiculari, apices plane-capitatos versus valde attenuata. Raphe area hyalina distincta, media in parte valvæ in aream centralem rotundatam dilatata, cincta. Striis radiantibus, media in valva alternatim longis abbreviatisqve. Nodulis terminalibus summis in apicibus situatis.

Loc. Hvalrosodde.

Pinnularia (Ehr.), 1843.

Gracillimæ Cl., 1895.

Pinnularia leptosoma Grun., Cl. Syn., II, 74; V. H. Syn., Tab. XII, fig. 29.

Loc. Off Cape Amélie (Algæ), Vester Elv.
Arct. Distr. E. Greenl., Fz. Js. Ld., J. M.

Capitatæ Cl., 1895.

Pinnularia appendiculata Ag., Cl. Syn., II, 75; V. H. Trt., Tab. II, fig. 93 (Nav. append.).

Loc. Hvalrosodde, Lille Snenæs.
Arct. Distr. W. Greenl.

Pinnularia interrupta W. Sm., *forma stauroneiformis*, Cl. Syn., II, 76; V. H. Trt., Tab. II, fig. 97 (Nav. mesolepta Termes).

Loc. Off Cape Amélie (Algæ).
Arct. Distr. E. Greenl.

Pinnularia mesolepta Ehr. var. *angusta* Cl., Cl. Syn., II, 76; A. S. Atl., Tab. XLV, fig. 62 (Nav. gracillima).

Loc. Hvalrosodde, Nostoc.
Not before recorded from Arctic regions. Several other records.

Pinnularia microstauron Ehr., Cl. Syn., II, 77; V. H. Syn., Tab. VI, fig. 9 (Nav. bicapitata hybrida).

Loc. Koldewey Isl. (Algæ).
Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld., J. M.

Pinnularia subcapitata Greg., Cl. Syn., II, 75; A. S. Atl., Tab. XLV, fig. 65 (Nav. Hilseana).

Loc. Hvalrosodde.
Arct. Distr. W. Greenl., E. of Greenl., Spb.

Divergentes Cl., 1895.

Pinnularia Brébissonii Kütz. var. *diminuta* H. V. H., Cl. Syn., II, 78; V. H. Trt., Tab. II, fig. 84 (Nav. Breb. dimin.)

Loc. Lille Snenæs, Vester Elv.
Arct. Distr. J. M.

Pinnularia Brébissonii var. *linearis* O. Müll. *forma curta*, O. Müll., Riesengeb., 25, Tab. III, fig. 3.

Loc. Vester Elv.

Not before recorded from Arctic regions. Other record, Riesengebirge.

Pinnularia divergens W. Sm. var. *linearis* var. nova. Tab. nost. XIV, fig. 11.

Long. 52 μ. Lat. 11 μ. Str. 8 in 10 μ.

Valva lineari apicibus rotundatis. Raphe area hyalina satis lata, media in valva in fasciam transapicalem dilatata, cincta. Incrassationibus marginalibus fasciæ evidentibus. Striis radiantibus sub apices convergentibus. Fissuris terminalibus figuram "commatis" præbentibus.

Loc. Vester Elv, Thermometerfjeld.

I have placed this form under *Pinn. divergens* because of the marginal incrassations of the fascia.

Pinnularia divergentissima Grun., Cl. Syn., II. 77; V. H. Syn., Tab. VI, fig. 32.

Loc. Hvalrosodde (2 sampl.), Vester Elv, Thermometerfjeld.

Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld., Spb., B. El., J. M.

Pinnularia Legumen Ehr., Cl. Syn., II, 78; V. H. Trt., Tab. II, fig. 98 (Nav. Legum.).

Loc. Vester Elv.

Not before recorded from Arctic regions. Several other records.

The present form is a forma parva; long. 54 μ.

Distantes Cl., 1895.

Pinnularia borealis Ehr., Cl. Syn., II, 80; V. H. Trt., Tab. II, fig. 77 (Nav. bor.).

Loc. Hvalrosodde (2 sampl.), Dove Bugt, Stormbugt, Stormkap, Vester Elv (2 sampl.), Thermometerfjeld.

Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld., Spb., B. El., J. M.

Pinnularia lata Bréb., Cl. Syn., II, 81; V. H. Trt., Tab. II, fig. 76 (Nav. lata).

Loc. Stormkap, Thermometerfjeld.

Arct. Distr. E. Greenl., Fz. Js. Ld., J. M.

Tabellarieæ Cl., 1895.

Pinnularia mesogongyla Ehr., Cl. Syn., II, 84; Cl., Diat. Finl., Tab. I, fig. 11.

Loc. Hvalrosodde, Vester Elv (3 sampl.).

Arct. Distr. E. Greenl.

Pinnularia stauroptera Grun. var. *interrupta* Cl. *forma parva*, Cl. Syn., II, 83; V. H. Trt., Tab. II, fig. 86 (Nav. staur. parva).

Loc. Hvalrosodde (2 sampl.), Lille Snenæs.

Arct. Distr. E. Greenl., Fz. Js. Ld.

Brevistriatæ Cl., 1895.

Pinnularia parva (Ehr.) Greg. var. *Lagerstedtii* Cl., Cl. Syn., II, 87, Lgst.; Spb., Tab. II, fig. 4 (Nav. parvula)

Loc. Dove Bugt, Lille Snenæs.
Arct. Distr. Spb., B. El.

Amphora Ehr., 1840.

Subgen. *Amphora* Cl., 1895.

Amphora ovalis Kütz var. *libyca* Ehr., Cl. Syn., II, 104; V. H. Trt., Tab. I, fig. 17 (Amph. oval. affinis).

Loc. Off Cape Amélie (Algæ), Koldewey Isl. (Algæ).
Arct. Distr. W. Greenl., E. of Greenl., Spb.

Monoraphideæ.

Cocconeis (Ehr., 1835) Grun., 1868.

Subg. *Cocconeis* Cl., 1895 pro gen.

Cocconeis Pediculus Ehr., Cl. Syn., II, 169; A. S. Atl., Tab. CXCII, fig. 61.

Loc. Koldewey Isl. (Algæ).
Not before recorded from Arctic regions. Several other records.

Cocconeis Placentula Ehr. var. *euglypta*, Cl. Syn., II, 170; V. H. Syn., Tab. XXX, figs. 33—34.

Loc. Danmarks Havn (Algæ).
Arct. Distr. Fz. Js. Ld.

Subg. *Eucocconeis* Cl., 1895 pro gen.

Cocconeis flexella Kütz. Cl. Syn., II, 179; V. H. Trt., Tab. VIII, fig. 322 (Achnantidium flexell.).

Loc. Hvalrosodde, Lille Snenæs.
Arct. Distr. E. Greenl., Spb., B. El.

Cocconeis flexella Kütz. var. *intermedia* var. nova. Tab. nost XIV, fig. 12.

Long. 38 μ. Lat. 14 μ. Str. media in valva 22 in 10 μ, apices versus densioribus.

Epitheca: Area centrali subqvadrata, satis magna.

Hypotheca: Raphe sigmoidea, area angusta hyalina, media in parte valvæ in aream centralem acuminatam dilatata, cincta.

Loc. Hvalrosodde.

Especially on account of the subquadrate area of the epitheca I think this form may be intermediate between *Coccon. flex.* and *Coccon. maxima forma minor.* As I have not seen the epitheca and the hypotheca separated, but only in situ I have indicated in my figure of the hypotheca the extent of the central area of the epitheca.

Cocconeis maxima (A. Cl.) Øst. *forma minor*, cf. A. Cl., Lul. Lappm., 24, Tab. I, figs. 22—23 (Achnanthid. maxim. A. Cl.).

Loc. Hvalrosodde.

A. Cleve states that the length of *Achnanthidium maximum* is 0.065 mm (an epitheca) and 0.075 mm (a hypotheca) and she says (l. c.) "Though not seen together, the two valves described above, found in the same sample, certainly belong to the same species."

On an average my specimens are somewhat smaller (Length 48—56 μ, only one specimen measures 60 μ), but otherwise they agree well with A. Cleve's figures.

As I have seen both valves in situ I can affirm that they are corresponding valves.

Cocconeis maxima var. *lanceolata* var. nova. Tab. nost XIV, fig. 14.

Long. 74 μ. Lat. 22 μ. Str., media in valva, 16—17 in 10 μ, apices versus densioribus.

Valva rhombice-lanceolata, apicibus rotundatis. Epitheca: Area centrali qvadrata magna. Hypotheca: Raphe sigmoidea, area hyalina angustissima, media in parte valvæ in aream parvam subcircularem dilatata, cincta. Striis radiantibus. Nodulis terminalibus, paululum a margine remotis, in spatio laterali nudo situatis.

Loc. Hvalrosodde.

As in the figure of *Cocc. flex. interm.*, so also here, I have indicated the extent of the central area of the epitheca as I have only seen both valves in situ.

Cocconeis minuta Cl., Cl. Syn., II, 179; Lgst., Spb., Tab. XIV., fig. 16 (Cocc. Thwaitesii var. β arctica).

Loc. Hvalrosodde, Nostoc.

Arct. Distr. E. Greenl.; Spb.

Achnanthes Bory, 1822.

Subg. *Microneis* Cl. 1995 pro gen.

Achnanthes linearis W. Sm., Cl. Syn., II, 188; V. H. Trt., Tab. VIII, fig. 335.

Loc. Hvalrosodde.

Not before recorded from Arctic regions. Several other records.

Achnanthes microcephala Kütz., Cl. Syn., II, 188; V. H. Trt., Tab. VIII, fig. 332.

Loc. Hvalrosodde (2 sampl.).

Arct. Distr. E. Greenl.

Subg. *Achnanthidium* Cl., 1895 pro gen.

Achnanthes coarctata Bréb., Cl. Syn., II, 192; Lgst., Spb., Tab. I, fig. 16 (Achnanthid. coarct. elineata).

Loc. Hvalrosodde (2 sampl.), Dove Bugt.

Arct. Distr. E. Greenl., Spb., J. M.

Brachyraphideæ.

Eunotia Ehr., 1837.

Eunotia Arcus Ehr.; V. H. Trt., 299, Tab. IX, fig. 362.

Loc. Hvalrosodde, Vester Elv.
Arct. Distr. W. Greenl., E. Greenl., Spb.

Eunotia Arcus var. *bidens* Grun.; V. H. Trt., l. c., fig. 365.

Loc. Hvalrosodde.
Arct. Distr. E. Greenl.

Eunotia Arcus var. *hybrida*; V. H. Syn., Tab. XXXIV, fig. 4.

Loc. Hvalrosodde.
Arct. Distr. E. Greenl.

Eunotia Arcus var. *minor* Grun.; V. H. Trt., l. c., fig. 363.

Loc. Hvalrosodde.
Not before recorded from Arctic regions. "Cum specie hinc inde" (De Toni Syll., p. 791).

Eunotia Arcus var. *uncinata* Grun.; V. H. Trt., 299, Tab. IX, fig. 364.

Loc. Vester Elv, Basiskæret, Nostoc.
Arct. Distr. W. Greenl.

Eunotia Diodon Ehr.; V. H. Trt., 303, Tab. XXX, figs. 829—830.

Loc. Hvalrosodde.
Arct. Distr. W. Greenl., E. Greenl., Spb.

Eunotia divisa Hérib. var. *arctica* var. nova. Tab. nost. XIV, fig. 13, cf. Hérib., Diat. foss. d'Auv., III, 1908, 35, Tab. XIV, fig. 4.

Long. 44 μ. Lat. 7 μ. Str. 15—17 in 10 μ sub apices, ceterum irregulariter distributis.

Valva margine dorsali curvata margine ventrali recta, apicibus rotundatis, marginem ventralem versus leniter incurvatis.

Loc. Off Cape Amélie (Algæ). Only a single specimen found.

The present variety differs from the main species especially by its irregularly arranged striæ. Otherwise it agrees well with the figure by Héribaud referred to above, but is somewhat smaller. It may perhaps be considered as only an abnormal specimen of the main species, which is a fossil recorded from "Dépot de Fraisse-Bas" (France).

Eunotia Faba (Ehr.) Grun.? var. *densestriata* Øst., Øst., Danske Diat., Tab. V, fig. 107.

Loc. Vester Elv.
Not before recorded from Arctic regions. Other record, Denmark.

The present form is somewhat larger (18 μ) than the Danish specimens (14 μ) and — as far as I can see — is also somewhat more coarsely striated (16 striæ in 10 μ, as compared with 20 in 10 μ); but as the striæ can be seen only with great difficulty, they may after all be identical.

Eunotia gracilis (Ehr.) Rabh.; V. H. Trt., 300, Tab. IX, fig. 368.

Loc. Hvalrosodde.

Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld., Spb., B. El., J. M.

Eunotia lunaris (Ehr.) Grun.; V. H. Trt., 303, Tab. IX, fig. 384.

Loc. Lille Snenæs.

Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld., J. M.

Eunotia lunaris (Ehr.) var. *subarcuata* (Næg.) Grun.; V. H. Trt., 304, Tab. IX, fig. 385.

Loc. Vester Elv.

Arct. Distr. J. M.

Eunotia major (W. Sm.) Rabh.; V. H. Trt., 300, Tab. IX, fig. 366.

Loc. Hvalrosodde (2 sampl.), Vester Elv (3 sampl.).

Not before recorded from Arctic regions. Several other records.

Eunotia paludosa Grun., Grun., Østerr. Diat. (1862), 336; V. H. Syn., Tab. XXXIV, fig. 9.

Loc. Vester Elv.

Arct. Distr. W. Greenl., Spb.

Eunotia parallela Ehr., A. Cl., Lul. Lappm., 28; V. H Syn., Tab. XXXIV, fig. 16 (Eun. par. forma angustior).

Loc. Vester Elv.

Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld.. Spb.

Eunotia parallela Ehr. var. *arcuata* var. nova. Tab. nost. XIV, fig. 15.

Long. (sc: chordæ arcus) 40 μ. Lat. 4 μ. Long. sagittæ arcus 10 μ. Str. 14 in 10 μ, transverse lineatis.

Valva arcuata, margine dorsali sub apices paululum declinante.

Loc. Lille Snenæs.

Eunotia pectinalis (Kütz) Rabh. *forma elongata*; V. H. Trt., 301, Tab. IX, fig. 371.

Loc. Lille Snenæs.

Not before recorded from Arctic regions. Other record, Lule Lappmark.

Eunotia pectinalis (Kütz.) var. *minor* (Kütz.) Rabh., A. Cl., Lul. Lappm., 31; V. H. Syn., Tab. XXXIII, figs. 20—21.

Loc. Vester Elv.

Arct. Distr. Fz. Js. Ld.

Eunotia prærupta Ehr. V. H. Trt., 302, Tab. IX, fig. 376.

Loc. Hvalrosodde.

Arct. Distr. E. Greenl.

Eunotia prærupta var. *bidens* Grun.; V. H. Trt. l. c. fig. 379.

Loc. Hvalrosodde.

Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld., J. M.

Eunotia prærupta var. *bigibba* Kütz. V. H. Trt. l. c., fig. 380.

Loc. Hvalrosodde, Lille Snenæs, Vester Elv.
Arct. Distr. E. Greenl., Fz. Js. Ld.

Eunotia prærupta var. *curta* Grun. V. H. Trt. l. c., fig. 377.

Loc. Hvalrosodde, Danmarks Havn, Vester Elv.
Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld.

Eunotia prærupta var. *inflata* Grun. V. H. Trt. l. c., fig. 378.

Loc. Hvalrosodde.
Not before recorded from Arctic regions. Other records unknown to me.

Eunotia prærupta var. *laticeps* Grun., A. Cl., Lul. Lappm., 34; V. H. Syn., Tab. XXXIV, fig. 25 (forma curta).

Loc. Hvalrosodde (2 sampl).
Arct. Distr. E. Greenl., Fz. Js. Ld., J. M.

Eunotia prærupta var. *Monodon* Øst., Øst., Ferskv. D. f. Østg., 273, Tab. I, fig. 11.

Loc. Hvalrosodde (2 sampl.).
Arct. Distr. E. Greenl.

Eunotia robusta Ralfs var. *Papilio* Grun. V. H. Syn., Tab. XXXIII, fig. 8.

Loc. Hvalrosodde (3 sampl.), Stormkap, Vester Elv (3 sampl.), Thermometerfjeld.
Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld., Spb.

Eunotia septentrionalis Øst., Øst., Ferskv. D. f. Østg., 274, Tab. I, fig. 10.

Loc. Hvalrosodde, Dove Bugt, Lille Snenæs, Vester Elv.
Arct. Distr. E. Greenl., Fz. Js. Ld.

Eunotia Triodon Ehr. V. H. Trt, 303, Tab. IX, fig. 387.

Loc. Stormkap.
Arct. Distr. W. Greenl., E. Greenl., Spb.

Eschatoraphideæ.

Surirella Turp., 1827.

Surirella ovalis Bréb. var. *minuta* Bréb. V. H. Trt., 373, Tab. XIII, fig. 588.

Loc. Off Cape Amélie (Algæ).
Arct. Distr. E. Greenl., B. El.

Surirella ovalis var. *ovata* Kütz. V. H. Trt. l. c., fig. 587.

Loc. Off Cape Amélie (Algæ).
Arct. Distr. E. Greenl.

Tropidoraphideæ.

Hantzschia Grun., 1877.

Hantzschia amphioxys (Ehr.) Grun., V. H. Trt., 381, Tab. XV, fig. 483 b.

Loc. Lille Snenæs (2 sampl.), Thermometerfjeld.
Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld., Spb., B. El., J. M.

Hantzschia amphioxys (Ehr.) var. *leptocephala* Øst., Øst., Ferskv. d. f. Østg., 276, Tab. I, fig. 8.

Loc. Hvalrosodde (3 sampl.), Lille Snenæs, Vester Elv, Thermometerfjeld.
Arct. Distr. E. Greenl.

Hantzschia amphioxys (Ehr.) var. *robusta* var. nova. Tab. nost. XIV, fig. 17.

Long. 176 μ. Lat. 15 μ. Punct. carinal. 4—5 in 10 μ. Str. 15 in 10 μ, punctatis.

Valva hantzschoidea, apicibus rostratis. Punctis carinalibus paululum in valvam prolongatis. Nodulo centrali eximie conspicuo.

Loc. Hvalrosodde.

Nitzschia (Hass., 1845, W. Sm.), Grun., 1880.

Dubiæ.

Nitzschia Nathorstii Brun, Brun, J. M. & E. Greenl., 9, Tab. II, fig. 5.

Loc. Hvalrosodde, Lille Snenæs.
Arct. Distr. Fz. Js. Ld., J. M.

Nitzschia thermalis (Kütz.) Grun. var. *intermedia* Grun. V. H. Trt., 389, Tab. XV, fig. 510.

Loc. Off Cape Amélie (Algæ).
Not before recorded from Arctic regions. Other record, Ard. Liég. (V. H. Trt. l. c.).

Grunowia.

Nitzschia Denticula Grun., V. H. Trt., 390, Tab. 15, fig. 514.

Loc. Hvalrosodde.
Arct. Distr. W. Greenl., E. Greenl., Spb.

Obtusæ.

Nitzschia subcapitata sp. nova. Tab. nost. XIV, fig. 18.

Long. 94 μ. Lat. 4 μ. Punct. carinal. 8 in 10 μ. Str. delicatissimis.

Valva fere lineari, apices subcapitatos versus unilateraliter attenuata. Nodulo centrali obscuro, an præsente?

Loc. Vester Elv.

Lanceolatæ Grun.

Nitzschia fonticola Grun. var.? Tab. nost. XIV, fig. 16.

Long. 13 μ. Lat. 4 μ. Punctis carinalibus 11—12 in 10 μ. Striis inconspicuis. Valva lanceolata, carena valde excentrica.

Loc. Hvalrosodde.

This small form may be allied to *Nitz. fontic.*, V. H. Syn., Tab. LXIX, figs. 16—17.

Nitzschia Hantzschiana Rabh. Cl. & Grun. A. D., 99; V. H. Syn., Tab. LXIX, figs. 1—2.

Loc. Vester Elv.

Arct. Distr. Fz. Js. Ld., Spb.

Nitzschia Palea (Kütz) W. Sm. var. *minuta* Bleisch., Cl. & Grun. A. D., 96; V. H. Syn., Tab. LXIX, fig. 23.

Loc. Danmarks Havn (Algæ).

Arct. Distr. E. Greenl., Fz. Js. Ld., J. M.

Nitzschia Palea var. *tenuirostris* Grun.; V. H. Trt., 402, Tab. XVII, fig. 556 (the second figure).

Loc. Hvalrosodde.

Arct. Distr. B. El., J. M.

Arraphideæ.

Ceratoneis Ehr., 1840.

Ceratoneis Arcus Kütz.; V. H. Trt., 306, Tab. X, fig. 401.

Loc. Lille Snenæs.

Arct. Distr. W. Greenl., E. Greenl., Fz. Js. Ld., Spb., B. El.

Synedra Ehr, 1831.

Synedra radians (Kütz.) Grun.; V. H. Trt., 312, Tab. X, fig. 423.

Loc. Hvalrosodde.

Not before recorded from Arctic regions. Several other records.

Synedra Ulna (Nitsch.) Ehr.?

Loc. Hvalrosodde, Koldewey Isl. (Algæ).

I have only seen a few fragments, so that an exact determination is impossible.

Synedra Vaucheriæ Kütz. var. *septentrionalis* var. nova. Tab. nost. XIV, fig. 19.

Long. 23—30 μ. Lat. 3,6 μ. Str. 16 in 10 μ, an punctatis?

Valva lineari apicibus capitatis subcapitatisve. Striis parallelis, altera in parte media valva deficientibus ibiqve areolam unilateralem relinqventibus.

Loc. Vester Elv (4 sampl.), Lille Snenæs.

As this small species occurs in the samples both free and also attached to the narrow branches of algæ, but never in the form of long bands, I

think it may be a *Synedra*, not a *Fragilaria*. A. Cleve (Beitr. z. Fl. d. Bär. Ins., 17, fig. 10) describes and figures a *Synedra Vaucheria* Kütz. var. *perminuta* Grun., which may be a smaller and non-capitate form of the present species.

Fragilaria Lyngb.

Fragilaria construens (Ehr.) Grun.; V. H. Trt., 325, Tab. XI, fig. 450.

Loc. Hvalrosodde.
Arct. Distr. W. Greenl., B. El.

Fragilaria (*mutabilis* (W. Sm.) Grun. var.?) *elliptica* Schumann de Toni Syll., 687 (Frag. ellipt.); V. H. Syn., Tab. XLV, fig. 15.

Loc. Hvalrosodde.
Not before recorded from Arctic regions.

Diatoma De Cand., 1805.

Diatoma hiemale (Lyngb.) Kütz. var. *mesodon* Kütz. V. H. Trt., 350, Tab. XI, fig. 471.

Loc. Off Cape Amélie (Algæ), Danmarks Havn (Algæ), Koldewey Isl. (Algæ).
Arct. Distr. W. Greenl.

Tabellaria Ehr., 1839.

Tabellaria flocculosa (Roth.) Kütz. V. H. Trt., 357, Tab. XI, fig. 478.

Loc. Hvalrosodde, Dove Bugt, Vester Elv (7 sampl.).
Arct. Distr. W. Greenl., E. Greenl., Spb., B. El., J. M.

Centricæ.

Melosira Ag.

Melosira varians Ag. V. H. Trt., Tab. XVIII, fig. 611.

Loc. Danmarks Havn.
Not before recorded from Arctic regions. Several other records.

Cyclotella Kütz., 1833.

Cyclotella antiqva W. Sm. V. H. Trt., 446, Tab. XXII, fig. 652.

Loc. Hvalrosodde (2 sampl.).
Arct. Distr. W. Greenl., E. Greenl., Spb.

Stephanodiscus (Ehr., 1845) Grun., 1880.

Stephanodiscus Astræa (Ehr.) Grun. var. *spinulosus* Grun., Grun., Fz. Js. Ld., 49, Tab. V., fig. 2.

Loc. Danmarks Havn (Algæ).
Arct. Distr. E. Greenl., Fz. Js. Ld.

Distribution of the Freshwater Diatoms.

		W. Gr.	E. Gr.	Fz. Js. Ld.	Spb.	B. El.	J. M.
	Achnanthes						
1	— coarctata	. .	x	. .	x	. .	x
2	— linearis	. .	. .	. .	. .	. .	. .
3	— microcephala	. .	x	. .	. .	. .	. .
	Amphora						
4	— ovalis *libyca*	x	x	. .	x	. .	. .
	Anomoeoneis						
5	— exilis	x	x	. .	. .	. .	. .
6	— zellensis	x	x	. .	. .	. .	. .
	Caloneis						
7	— Clevei	. .	x	. .	x	. .	x
8	— fasciata	. .	. .	. .	x	. .	x
9	— lepidula	. .	. .	. .	. .	. .	. .
10	— Silicula *alpina*	. .	x	. .	x	. .	x
11	— — *ventricosa*	. .	. .	x	. .	. .	. .
	Ceratoneis						
12	— Arcus	x	x	x	x	x	. .
	Cocconeis						
13	— flexella	. .	x	. .	x	x	. .
14	— minuta	. .	x	. .	x	. .	. .
15	— Pediculus	. .	. .	. .	. .	. .	. .
16	— Placentul. *euglypt.*	. .	. .	x	. .	. .	. .
	Cyclotella						
17	— antiqva	x	x	. .	x	. .	. .
	Cymbella						
18	— æqvalis	x	x	. .	. .	. .	. .
19	— angustata	x	x	. .	x	. .	. .
20	— affinis *tumida*	. .	x	. .	x	. .	. .
21	— Botellus	. .	x	. .	x	. .	. .
22	— Cesatii	x	x	. .	. .	. .	. .
23	— gracilis *lunata*	x	x	. .	x	. .	. .
24	— hebridica	. .	. .	. .	. .	. .	. .
25	— heteropleur. *minor*	. .	x	x	x	. .	. .
26	— leptoceros	. .	. .	. .	. .	. .	. .
27	— naviculiformis	x	x	. .	x	x	. .
28	— siunata	. .	. .	. .	. .	. .	. .
29	— stauroneiformis	. .	x	x	x	. .	. .
30	— ventricosa	x	x	x	x	. .	. .
31	— — *ovata*	. .	. .	. .	. .	. .	. .
32	— — *semicircular.*	. .	x	. .	x	. .	. .
		11	22	6	18	3	4

		W. Gr.	E. Gr.	Fz. Js. Ld.	Spb.	B. El.	J. M.
	Diatoma						
33	— hiemale *mesodon.*	x	. .	. .	. .	. .	. .
	Diploneis						
34	— oculata	. .	. .	. .	. .	. .	. .
35	— Puella	x	. .	. .	x	. .	. .
	Eunotia						
36	— Arcus	x	x	. .	x	. .	. .
37	— — *bidens*	. .	x	. .	. .	. .	. .
38	— — *hybrida*	. .	x	. .	. .	. .	. .
39	— — *minor*	. .	. .	. .	. .	. .	. .
40	— — *uncinata*	x	. .	. .	. .	. .	. .
41	— Diodon	x	x	. .	x	. .	. .
42	— gracilis	x	x	x	x	x	x
43	— lunaris	x	x	x	. .	. .	x
44	— — *subarcuata.*	. .	. .	. .	. .	. .	x
45	— major	. .	. .	. .	. .	. .	. .
46	— paludosa	x	. .	. .	x	. .	. .
47	— parallela	x	x	x	x	. .	. .
48	— pectinalis *elong.*	. .	. .	. .	. .	. .	. .
49	— — *minor*	. .	. .	x	. .	. .	. .
50	— prærupta	. .	x	. .	. .	. .	. .
51	— — *bidens*	x	x	x	. .	. .	x
52	— — *bigibba*	. .	x	x	. .	. .	. .
53	— — *curta*	x	x	x	. .	. .	. .
54	— — *inflata*	. .	. .	. .	. .	. .	. .
55	— — *latic. curta*	. .	x	x	. .	. .	x
56	— — *monodon*	. .	x	. .	. .	. .	. .
57	— septentrionalis	. .	x	x	. .	. .	. .
58	— Triodon	x	x	. .	x	. .	. .
59	— robusta *Papilio*	x	x	x	x	. .	. .
	Fragilaria						
60	— construens	x	. .	. .	. .	x	. .
61	— mutabilis *elliptica*	. .	. .	. .	. .	. .	. .
	Frústulia						
62	— rhomboid. *leptoc.*	. .	x	. .	. .	. .	. .
	Hantzschia						
63	— amphioxys	x	x	x	x	x	x
64	— — *leptocephala*	. .	x	. .	. .	. .	. .
	Melosira						
65	— varians	. .	. .	. .	. .	. .	. .
		15	19	11	9	3	6

		W. Gr.	E. Gr.	Fz.Js.Ld.	Spb.	B. El.	J. M.
	Navicula						
66	— anglica	..	..	..	..	..	..
67	— Atomus *circul.*	..	..	..	..	..	..
68	— bacilliformis	..	..	..	..	..	..
69	— capitata	..	..	x	..	..	..
70	— cincta	..	..	x	..	..	..
71	— cocconeiformis	x	x	..	x	x	x
72	— contenta	..	x	..	..	..	..
73	— dicephala	..	..	..	..	..	x
74	— gibbula	..	x	x	x	..	x
75	— — *capitata*	..	x	..	x	..	..
76	— Lagerstedtii	..	x	..	x	..	..
77	— falaisensis	x	..	..	..	..	..
78	— Gastrum	x	x	..	..	..	..
79	— lanceolata	..	..	..	..	..	..
80	— — *tenella*	..	..	..	..	..	..
81	— lucidula	..	..	..	..	..	..
82	— mutica f. *Cohnii*	x	x	x	x	..	x
83	— — *Goeppertiana*	..	..	..	..	..	..
84	— — *ventricosa*	..	x	x	..	..	x
85	— nivalis	..	..	x	..	..	..
86	— Heufleriana	..	..	x	..	..	..
87	— Placentula	..	..	..	..	..	..
88	— radiosa	x	x	..	x	x	..
89	— rhyncocephala	..	..	..	..	x	..
90	— Rotæana	..	x	..	x	x	x
91	— Seminulum	x	..	..	x	..	..
92	— viridula *slesvicens.*	x	x	..	..	..	..
	Neidium						
93	— affin. gen. *minor*	..	..	..	x	..	..
94	— — *longiceps*	x	..	..	..	..	..
95	— bisulcatum	x	x	x	x	..	x
96	— decoratum	..	x	..	..	..	..
97	— Iridis	..	x	x	..	..	..
	Nitzschia						
98	— Denticula	x	x	..	x	..	..
99	— Hantzschiana	..	..	x	x	..	..
100	— Nathorstii	..	..	x	..	..	x
		10	15	11	12	4	8

		W. Gr.	E. Gr.	Fz.Js.Ld.	Spb	B. El.	J. M.
101	(Nitzschia) Palea *minuta*	..	x	x	..	..	x
102	— — *tenuir*	..	..	..	..	x	x
103	— thermal. *intens.*	..	..	..	..	..	..
	Pinnularia						
104	— appendiculata	x	..	..	..	..	..
105	— borealis	x	x	x	x	x	x
106	— Brébissonii *dimin.*	..	..	..	..	..	x
107	— linearis *curta*	..	..	..	..	..	..
108	— divergentissima	x	x	x	x	x	x
109	— interrupta *staur.*	..	x	..	..	..	..
110	— lata	..	x	x	..	..	x
111	— Legumen	..	..	..	..	..	..
112	— leptosoma	..	x	x	..	..	x
113	— mesogongyla	..	x	..	..	..	..
114	— mesolepta *angusta*	..	..	..	..	..	..
115	— microstauron	x	x	x	..	..	x
116	— parva *Lagerstedtii*	..	..	..	x	x	..
117	— staur. *interr.* parva	..	x	x	..	..	..
118	— subcapitata	x	x	..	x	..	..
	Stauroneis						
119	— anceps	x	x	..	x	..	x
120	— javanica *oblonga*	..	x	..	..	..	..
121	— — *truncata*	..	x	..	..	..	..
122	— obtusa	..	..	..	x	x	..
123	— parvula	..	..	..	..	..	..
124	— Phoenic. *amphil.*	x	x	x	..	..	..
	Stephanodiscus						
125	— Astræa *spinul.*	..	x	x	..	..	..
	Surirella						
126	— ovalis *minuta*	..	x	..	..	x	..
127	— — *ovata*	..	x	..	..	..	..
	Synedra						
128	— radians	..	..	..	..	..	..
	Tabellaria						
129	— flocculosa	x	x	..	x	x	x
		8	18	10	7	6	10
	Total	44	74	38	46	16	28

The above list shows, that the total number of freshwater forms is 128, and of these there were previously known

from W. Greenland ..... 44 (34.1 %)
— E. Greenland ..... 74 (57.4 %)
— Franz-Josef Land ..... 38 (29.5 %)

from Spitzbergen	46	(35.7 %)
— Beeren Eiland	16	(12.4 %)
— Jan Mayen	28	(21.7 %)
not recorded	28	(21.7 %),
hence previously known from the Arctic regions	101	(78.3 %).
From W. Greenl. only, and from no other Arctic locality	11	(8.5 %).
From the localities east of E. Greenl., taken as a whole	76	(58.9 %).

This proves that the freshwater-Diatom-flora from East Greenland which we are here considering obviously originates from the east, and as regards the eastern localities, more particularly from Spitzbergen.

To this may be added that five of the forms which have been found, viz.

Cymbella affinis *tumida*
— Botellus
— ventricosa *semicircularis*
Navicula gibbula *capitata* and
— Lagerstedtii,

have hitherto — outside Greenland — been found only in Spitzbergen; and a similar origin is indicated for some of the Desmidiaceæ found by Dr. F. BÖRGESEN (cf. F. Börgesen: Freshw. Algæ, p. 73).

Fig. 1. Caloneis septentrionalis sp. nova ..... Page 233
— 2. Navicula gibbula Cl., var. *capitata* Lgst. ..... — 236
— 3. Stauroneis dilatata Ehr. *forma minor* ..... — 236
— 4. Cymbella septentrionalis sp. nova ..... — 238
— 5. Gomphonema boreale sp. nova ..... — 239
— 6. Anomoeoneis zellensis Grun. var. *linearis* var. nova ..... — 239
— 7. Navicula anglica Ralfs *forma elongata* ..... — 240
— 8. — gracilis Ehr. var. *obesa* var. nova ..... — 240
— 9. — sp. ..... — 241
— 10. — pusilla W. Sm. var. *capitata* var. nova ..... — 241
— 11. Pinnularia divergens var. *linearis* var. nova ..... — 243
— 12. Cocconeis flexella Kütz var. *intermedia* var. nova ..... — 244
— 13. Eunotia divisa Hérib. var. *arctica* var. nova ..... — 246
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— 19. Synedra Vaucheriæ Kütz. var. *septentrionalis* var. nova ..... — 250

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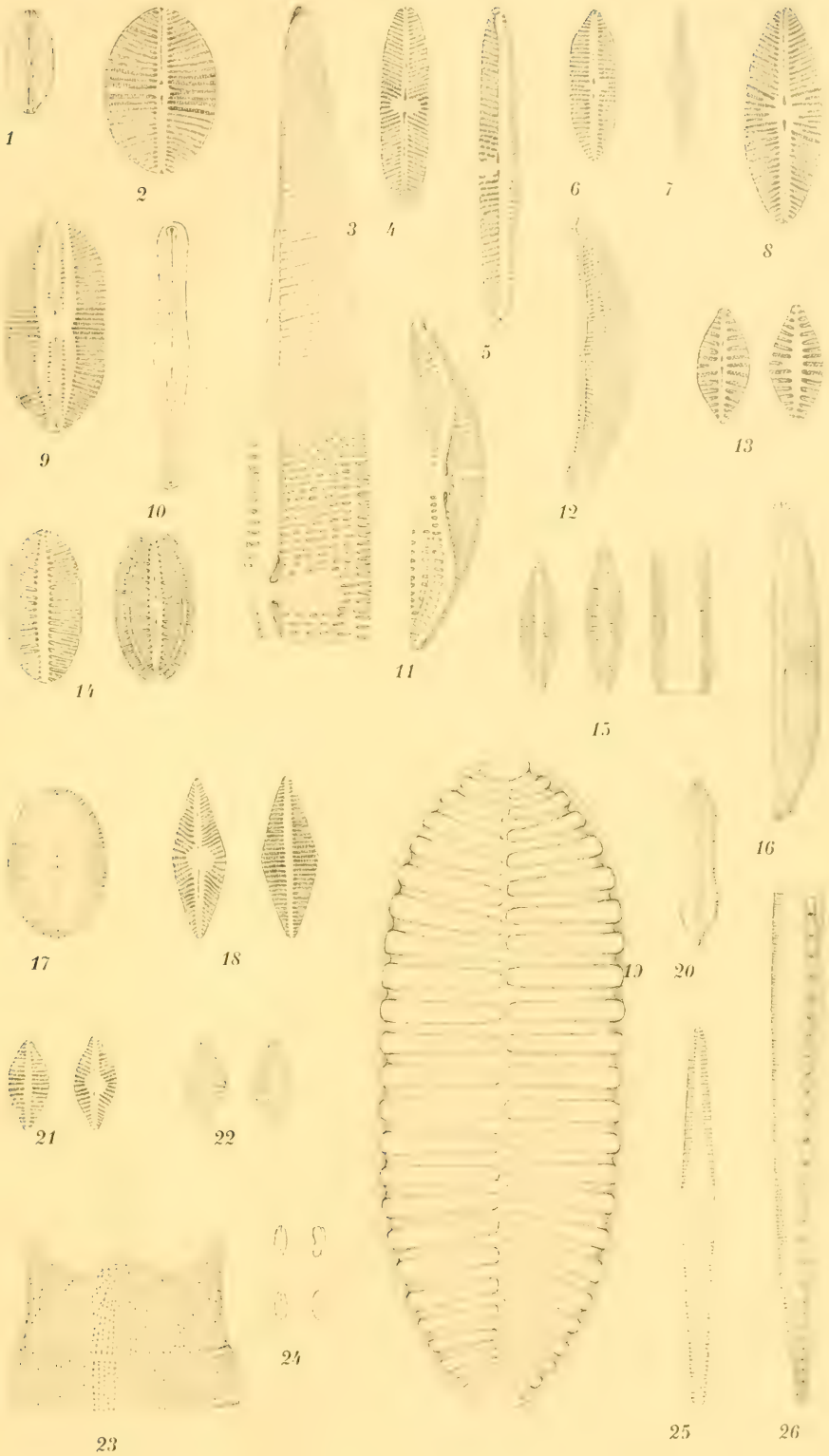

Aut. del.

XI.

MARINE PLANKTON

FROM

THE EAST-GREENLAND SEA

(W. OF 6° W. LONG. AND N. OF 73° 30′ N. LAT.)

COLLECTED DURING THE "DANMARK EXPEDITION" 1906—1908

I. LIST OF DIATOMS AND FLAGELLATES

BY

C. H. OSTENFELD

1910

INTRODUCTION

During the outward and homeward voyages of the Danmark-Expedition in 1906 and 1908 to and from N. E. Greenland the botanical collector Mr. A. Lundager has procured a large series of samples af surface plankton by means of using tow-nets with fine-meshed silk-gauze (Millergauze No. 20). Also during the stay in Danmarks Havn (Denmark Harbour), Germania Land, 76°46' N. Lat., 18°43' W. Long., some collections were made.

Of late years several expeditions have crossed the Greenland Sea and brought home collections of plankton. Therefore it was not likely that the plankton samples of the Danmark Expedition should give much new, especially not with regard to the samples taken in the open Greenland Sea east and south of the pack-ice (drift-ice). The main interest must lie in the samples from the pack-ice itself and from the coastal water inside it, and further in the samples from Danmarks Havn. I have consequently limited my examination to the samples taken in these regions and have not wasted my time by examining the other samples which would have given only a feeble and chance knowledge of the plankton of the open Greenland Sea, based, as it must have been, upon material from two crossings alone and both in July—August.

It would have been of the highest value if the Expedition had taken samples at regular intervals, e. g. fortnightly, during the whole time of the stay in Danmarks Havn from August 1906 to July 1908, as we know very little of the seasonal changes in arctic coast-plankton. The only source is Vanhöffen's investigations from Karajak Fjord in West Greenland, ca, 70° N. Lat., (Drygalski Expedition 1892—93), and it is easily understood that a comparison with those would have been much appropriate. Unfortunately the collection from Danmarks Havn is very incomplete; it consists of some samples from the time between June 15th and September 10th 1907 and a couple from July 21st 1908 when the steamer left the harbour. There is here lost a chance which, perhaps, will not come again for years.

As to the samples collected before and after the stay in Danmarks Havn, we have (1°) a fair collection from August 1906 and July 1908 taken in the more or less ice-filled water along the coast from off Koldewey Island (ca. 76°30′ N. Lat.) to ca. 78° N. Lat., and further (2°) an interesting collection from the traversing of the pack-ice in both years (July—August). During the homeward voyage in July 1908 the samples from the coastal water and the pack-ice were taken with intervals of only one or a few hours, and a preliminary examination soon showed that it was not necessary to work out more than a selected number. In the following list I have enumerated the species of Diatoms and Flagellates, in another paper Mr. OVE PAULSEN will treat of the Peridinians. With regard to the Zooplankton the collecting method with small open conical nets of fine-meshed silk-gauze is not well adapted to the capture of the larger organisms, metazoa; other samples taken by the Expedition with larger coarse-meshed nets and at different depths give better results; they will form the subject of papers by zoologists; it will, therefore, not be necessary to undertake a closer examination of the surface samples in this respect. On the other hand, the Protozoa, at least the Tintinnodea, require fine-meshed nets for catching, and in a little separate paper I shall enumerate the species of protozoa found in the samples.

Finally Mr. PAULSEN and I in common will write on the surface plankton samples as a whole describing the general character of the plankton, the supposed origin of the organisms, etc. under comparison with the hydrographical conditions and using the papers published by other planktologists on the plankton of the East Greenland Sea.

The list here given contains the names of all the plankton Diatoms and Flagellates determined from the samples, with quotations of the first description, of the more important synonyms and figures, as well as of the general works (e. g. GRAN's Diatoms in Nordisches Plankton). Critical remarks elucidated by figures are annexed to several species. The list further gives the occurrence in the region, divided into the three above mentioned areas: Danmarks Havn, the coastal water and the pack-ice, and the time for the presence in the plankton, as far as the scanty data allow it. At last the area of distribution is given summarily. The examination did comprise 64 samples.

The littoral diatoms and the diatoms of the ice-floes are determined by Mr. E. ØSTRUP who publishes his results together with a treatment of the freshwater diatoms.

The following papers deal with the phytoplankton from the East Greenland Sea:

Broch, Hj., (1909): Plankton-tables, in D. Damas et E. Koefoed, Le Plankton de la Mer du Grønland. — Duc d'Orleans: Croisière Océanographique accomplie à bord de La Belgica dans la Mer du Grønland 1905. Bruxelles.

Cleve, P. T., (1900): Report on the Plankton collected by the Swedish Expedition to Greenland in 1899. — K. Svenska Vet. Akad. Handl., Bd. 34, Nr. 3. Stockholm.

Østrup, E., (1895): Marine Diatoméer fra Øst-Grønland. — Medd. om Grønland, XVIII. København.

Hereto the two general works may be added:

Gran, H. H., (1904): Die Diatomeen der arktischen Meere. I. Teil: Die Diatomeen des Planktons — Fauna Arctica, herausgegeben von F. Römer u. F. Schaudinn, Bd. III. Heft 3. Jena.

— (1905): Diatomeen. — Nordisches Plankton, herausgegeben von K. Brandt. XIX. Kiel u. Leipzig.

I. Bacillariales (Diatoms).

A. Centricæ.

Melosira Ag., 1824[1].

1. **Melosira hyperborea** (Grun.) Schütt, in Engler & Prantl, Nat. Pflanzenfam., I. 1 b, 1896, p. 59; Gran, Norweg. North Polar Exp., Scientif. Results, vol. 4, No. 11, 1900, p. 52. pl. 3, figs. 11—15. *M. nummuloides*. var.? *hyperborea* Grunow in V. Heurck, Synopsis, pl. 85, figs. 3—4.

The species is one of the most characterizing diatoms from the ice-floes. It often occurs in practically pure mass cultures in holes in the ice-floes and in spaces between them. Both in 1906 and in 1908 several samples from the pack-ice had this species as their main organism. In most samples from July and August it had resting spores, answering well to the excellent figures in GRAN's paper quoted above. In October 1906 the samples from Danmarks Havn contained a few empty frustules, and in September 1907 the case was nearly the same, i. e. at that time the vegetation period was over. In June (15th) 1907 a sample collected in a crack of the land-ice shows us the species in full growth, the chains consisting of frustules in rapid division and with no trace of resting spores. In the later half of July 1908 most of the samples from the coastal water and some from the inner part of the pack-ice contained it, in several of them even as common, and in nearly all samples resting spores were present. Thus we get an idea of its life-cycle, as we must suppose that it winters as resting spores, probably frozen in the ice.

Distrib. Arctic neritic species known from the arctic coast regions and from the inner Baltic.

Thalassiosira Cleve, 1873.

2. **Thalassiosira Nordenskiöldii** Cleve, Bih. K. Svenska Vet. Akad. Handl., Bd. I, No. 13, 1873, p. 6, pl. II, fig. 1; Gran, Norske Nord-

[1] I have followed the consecutive order of genera and species given in GRAN, Nord. Plankton XIX.

havs-Exp., Protophyta, 1897, p. 28, pl. IV, fig. 59; Nord. Plankton XIX, 1905, p. 16, fig. 9.

This species is rather rare in the collection; it has been found in a single sample from the pack-ice in 1906, in some samples from Danmarks Havn in 1907 and 1908, and in several ones from the coastal water and the pack-ice in 1908, but never commonly. The time where it "flowers" must be very short in these high latitudes as it has not been present in the June and July (first half) samples from Danmarks Havn. No resting spores were seen. July—September.

Distrib. Northern neritic species widely distributed along the coast regions of the northern countries.

3. **Thalassiosira decipiens** (Grun.) Jørgensen, Bergens Museums Skrifter, 1905, p. 96, pl. 6, fig. 3; Gran, Nord. Plankton, 1905 XIX, p. 17, fig. 10; Ostenfeld, Wiss. Ergeb. Aral See Exp., VIII, 1908, p. 144, pl. 6, figs. 6—8; *T. gelatinosa* Hensen, 5. Ber. Komm. Deutsch. Meere, 1887, p. 87; *Coscinodiscus excentricus,* var.? *decipiens* Grunow, Sitzungsber. naturw. Ges. Isis, Dresden, 1878, p. 28, pl. 6, fig. 18; *C. decipiens* Grunow in Van Heurck, Synopsis, 1883, pl. 91, fig. 10.

Found sparingly in four samples from the outer margin of the pack-ice in 1906, not elsewhere. July—August.

Distrib. Northern temperate species known from the coast regions of North and West-Europe, further from the Caspian and Aral Seas; not formerly found in arctic water, where it has not its home.

4. **Thalassiosira hyalina** (Grun.) Gran, Bibliotheca bot. Heft 42, 1897, p. 4, pl. 1, figs. 17—18; Nord. Plankton XIX, p. 17; E. Jørgensen, Bergens Museums Skrifter, 1905, p. 96, pl. VI, fig. 5; *Th. Clevei* Gran, Norske Nordhavs Exp., Protophyta, 1897, p. 29, pl. 4, figs. 60—62; *Coscinodiscus hyalinus* Grun. in Cleve & Grunow, K. Svenska Vet-Akad. Handl., Bd. 17, No. 2, 1880, p. 113, pl. 7, fig. 128; Grunow, Diat. v. Franz Josefs Land, 1884, p. 30, pl. C, fig. 28.

It is rather curious that I have found this species, so characteristic for the ice-floes, only very rarely and in a few samples from the pack-ice in August 1906.

Distrib. Arctic-neritic species known from the ice-floes and the coasts of the arctic Sea (reaching as far south as Stadt in Norway).

5. **Thalassiosira gravida** Cleve, Bih. K. Svenska Vet. Akad. Handl., Bd. 22, afd. 3, No. 4, 1896, p. 12, pl. 2, figs. 14—16; Gran, Norske Nordhavs-Exp., Protophyta, 1897, p. 28, pl. 4, figs. 57—58; Nord. Plankton XIX, p. 18, fig. 12; *Coscinodiscus subglobosus* Cleve & Grun. in Grunow, Diat. v. Franz Josefs Land, 1884, p. 32, pl. D, figs. 19—20.

In the samples from 1906 this species was only found twice and in very few specimens; also in 1907, in the samples from Danmarks Havn it was rare. In 1908, on the other hand, it was common in many of the samples on the whole way from Danmarks Havn through the pack-ice. In several samples the cells were very small, so-called hunger-specimens. The resting spores (*Coscinod. subglobosus*) were present in two samples (Septm. 1907, July 1908). July—August—September.

Distrib. Northern neritic species widely distributed along the coast bordering the Arctic and North Atlantic Oceans and their tributaries.

6. **Thalassiosira bioculata** (Grun.) Ostenfeld, Bot. of the Færöes, vol. 2, 1903, Copenhagen, p. 564, figs. 120—121; Gran, Nord. Plankton XIX, p. 19, fig. 14; *Coscinodiscus b.* Grunow, Diat. v. Franz Josefs Land, 1884, p. 30 et 56, pl. C, fig. 30, pl. D, figs. 1—2.

Single individuals were found in several of the samples from Danmarks Havn, the coast water and also in the pack-ice. Chains are not seen and the species was not found in stage of strong growth. July—August—September.

Distrib. Northern neritic species known from the coast regions of the northern countries bordering the Davis Strait, northern Atlantic and Arctic Oceans.

Bacterosira Gran, 1900.

7. **Bacterosira fragilis** Gran, Nyt Mag. Naturvid., Christiania, 38, 1900, p. 114; Nord. Plankton, 1905, XIX, p. 21; *Lauderia f.* Gran, Bibliotheca botanica, Heft 42, 1897, p. 18, pl. 1, figs. 12—14.

Found very sparingly in samples from Danmarks Havn and the coast-water, not in the pack-ice. July—August.

Distrib. Arctic neritic species known from the coasts of the arctic Sea (West- and East-Greenland, Spitsbergen, Nova Zembla) and from the northern coast of Norway.

Lauderia Cleve, 1873.

8. **Lauderia glacialis** (Grun.) Gran, Nyt Magaz. Naturvid., Christiania, Bd. 38, 1900, p. 111, pl. 9, figs. 10—14; Nord. Plankton, XIX, p. 23; *Podosira hormoides*, var. *glacialis* Grunow, Diat. Franz Josefs Land, 1884, p. 56, pl. C, fig. 32; *P. glacialis* Cleve, Bih. K. Svenska Vet. Akad. Handl., Bd. 22, afd. 3, No. 4, 1896, p. 12, pl. 2, figs. 17—20; *Porosira g.* Jørgensen, Bergens Museums Skrifter, 1905, p. 97, pl. 6, fig. 7.

Rare in the samples, found in Danmarks Havn and in the coast water, not in the pack-ice. July—August.

Distrib. Northern (subarctic) species known from the coastal regions of the arctic Sea and along the coasts of North-Europe (in winter).

Hyalodiscus Ehrbg., 1845.

9. **Hyalodiscus laevis** Ehrbg., Monatsber. Berlin. Akad. Wissensch. 1845, p. 78; Cleve u. Grunow, K. Svenska Vet. Akad. Handl., Bd. 17, No. 2, 1880, p. 116; Peragallo, Diatom marin. de France, pl. 119, fig. 20; *H. subtilis* Bailey, Smithson. Contrib. to knowledge, vol. 7, 1854, p. 10, fig. 12; W. Hendry, Quart. Journ. Microsc. sc., 1861, p. 179; Cleve u. Grunow, l. c.; Gran, Bibliotheca botanica, Heft 42, p. 5, pl. 1, fig. 19; Peragallo, l. c., pl. 119, fig. 7. Cfr. Stockmayer, Annal. k. k. naturh. Hofmuseum, Wien, XXIII, 1909, p. 69.

In some samples from Danmarks Havn I found sparingly a large species (150—170 μ in diameter of the valve) of *Hyalodiscus* which, I think, is identical with Gran's *H. subtilis* from Karajak Fjord. On the other hand I cannot find any difference of valve between *H. lævis* Ehrbg. and *H. subtilis* Bail. Already Hendy (l. c.) has suggested that the distinctive marks in the proportion between the entire valve and the central part *(umbilicus)* as well as in the structure of the "*umbilicus*" are value-less, and my here given figures (Fig. 1) which

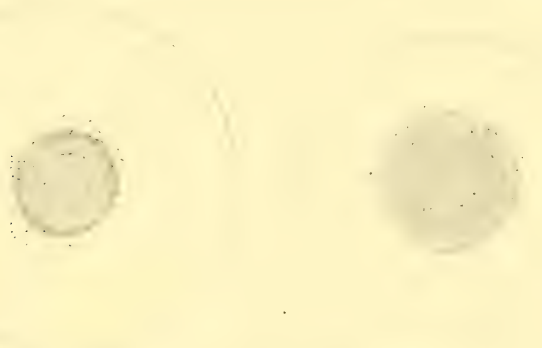

Fig 1. *Hyalodiscus laevis* Ehrbg. 250 t. m.

are chosen as extremes will, taken together with the figures by Peragallo, show that these characters are subject to great variability. Therefore, I find it necessary to unite the two species in one to which *H. scoticus* (Kutz.) Grun. must be referred as a dwarfy variety. — July—September.

Distrib. Coast-species, not true plankton form, found scattered over the earth, especially in colder regions; often found in fossil depots.

Coscinodiscus Ehrbg., 1838.

10. **Coscinodiscus centralis** Ehrbg., Abhandl. Berl. Akad., 1838, p. 129; Mikrogeologie, pl. 18, fig. 39. pl. 22, fig. 1; Jørgensen, Bergens Museums Skrifter, 1905, p. 93, pl. 6, fig. 1; Gran, Nord. Plankton XIX,

1905, p. 33, fig. 33: Ostenfeld, Wiss. Ergebn. Aral-See Exped., VIII, St. Petersburg, 1908, p. 149, pl. 7, figs. 4—5.

In a sample from the outer part of the pack-ice a single dead frustuce of this species was found. August 1906.

Distrib. Widely distributed oceanic species, according to Gran common, especially during winter, in the Gulf-Stream area of the Norwegian Sea and in the North Atlantic; not at home in arctic water.

11. **Coscinodiscus subbuliens** Jørgensen, Bergens Museums Skrifter 1905, p. 94, pl. VI, fig. 2; Gran, Nord. Plankton XIX, 1905, p. 32, fig. 32; *C. oculus iridis* Gran, Fauna Arctica, III, Lief. 3, 1904, p. 519, pl. XVII, figs. 17—19.

The species which I refer to Jørgensen's *C. subbuliens* is very common in some of the samples from the autumn, indeed forming the main part of the phytoplankton.

Owing to the abundance of material I have been able to add some points to the descriptions given by Jørgensen and Gran. As to the size of the species Jørgensen gives a diameter of "usually 50—100 μ", and Gran says 65—150 μ, while my measurements extend it to 240 μ (185 μ as mean of 20 measurements) for the normal vegetative cells. The valves are coarsely areolated in a radiate manner, and in contradistinction to the descriptions of the two quoted authors I have found that, at a certain adjustment, a single row of very small points or *apiculi* are discernible a little inside the margin and further, asymmetrically among them, two larger *apiculi* or knots, at a distance from one another of between 120° and 150°. The *apiculi* which are difficult to see, best upon ignified material mounted in styrax-balsam, stand rather closely, as between two usually 3—4 radii of areoles originate. The existence of the two larger apiculi shows that *C. subbuliens* must be referred to the Group *Biapiculati* created by me in 1908 (Wiss. Ergebn. d. Aralsee-Exp., Lief. VIII, St. Petersburg, 1908, p. 147). Further investigations must decide, if all species of the sectio *Radiati* Rattr. possess these two *apiculi*: hitherto they have been found in *C. biconicus* Van Breem., *C. aralensis* Ostf., *C. Granii* Gough, *C. centralis* Ehrbg. and *C. concinnus* W.

Gran (1904, fig. 19) has figured the construction of the girdle of a specimen which just has divided into two daughter-cells and where the matter is more complicated than in the ordinary cells. Therefore I have given a figure (Fig. 2) showing the girdle of a normal cell[1]. This figure represents only a part of the girdle, but it is seen distinctly, that in the connecting part of each valve two structure-lines

[1] The fig. 32 c in Gran's paper of 1905 is not quite clear in this respect.

run parallel to its margins, one thin line near the margin and one much coarser line situated more or less half way between the margin and the margin of the valve. The first named line makes a deviation from the parallel in one place, where it bends rather abruptly towards the coarse line and merges into it on a very short way, thus forming a V-shaped figure with the tip cut off; in this place the line is coarser than elsewhere and coarsest where it disappears in the other line. The V-shaped places of the two connecting parts of a cell never face each other, oftenest they are on the opposite halfs of the girdle, but sometimes rather near each other, as e. g. shown in fig. 3, to the right. The narrow part of the V is always directed towards the corresponding valve.

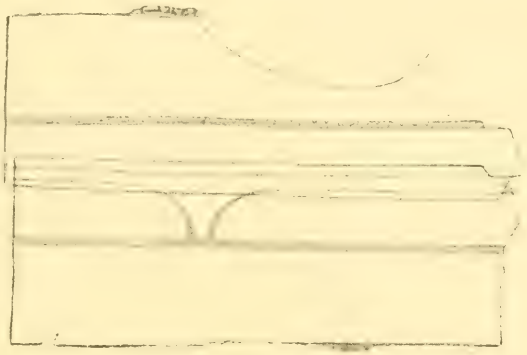

Fig. 2. *Coscinodiscus subbuliens* Jørg. An empty and partly broken frustule. Height 85 μ. 500 t. m.

In two samples from August—September 1907 where *Cosc. subbuliens* was dominant, I happened to find among the numerous normal cells some few auxospores or more correctly cells developed from auxospores.. Figs. 3—4 represent such cases: A large cell (diameter in a few measured specimens 280—320 μ) carries on the one valvar side the folded and crumpled rest of the *perizonium*; the cell itself is very young which is seen from the absence of a distinct girdle-part; the nucleus is situated close to the innerside of that valve, which turns away from the *perizonium*. I did not succeed in finding other stages, but the knowledge at hand is sufficient to show that the auxospore formation probably goes on in the same manner as in *Thalassiosira gravida* (Gran, Norske Nordhavs-Exp., Protophyta 1897) or in *Melosira* (see f. i. G. Karsten, Wissensch. Meeresunters., 1899, p. 183), with the difference that follows from the fact that the cells of *Cosc. subbuliens* occur solitary, not in chains. Hence it results that the auxospores immediately become separated from their mother-cells, which makes it difficult to observe them.

Fig. 3. *Coscinodiscus subbuliens* Jørg. The two figures to the left represent the same cell. All 71 t. m.

G. Karsten (l. c., p. 185) reports that he has found auxospores in *Cosc. radiatus* and Klebahn in *Cosc. excentricus*, but closer informations are not, as far as I know, given concerning the occurrence of this phenomenon in the genus *Coscinodiscus*.

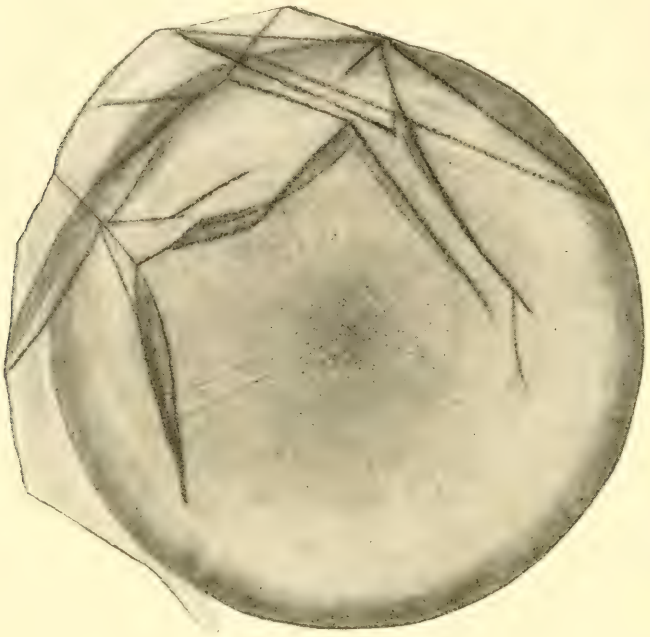

Fig. 4. *Coscinodiscus subbuliens* Jørg. 250 t. m.

Cosc. subbuliens was dominant in samples from Danmarks Havn and from the coast water in 1906, 1907 and 1908 in July—September. Few living specimens were present in two samples from October 1906 taken in cracks in the ice of Danmarks Havn. In the pack-ice it was very rare, only few specimens seen in a couple of samples.

Distrib. According to Gran a boreal species occurring especially in the regions where polar and atlantic currents meet, often in large quantities.

12. **Coscinodiscus marginatus** Ehrbg., Abhandl. Berlin. Akad. Wissensch., 1841, p. 142; A. Schmidt, Atlas Diatom.-Kunde, pl. 62, figs. 1—5, 9—11; pl. 59, fig. 11; *C. fimbriato-limbatus* A. Schmidt, l. c., pl. 65, figs. 3—6; pl. 113, fig. 2; *C. limbatus* A. Schmidt, l. c., pl. 63, fig. 7; Ostenfeld & Paulsen, Medd. Grønland, XXVI, 1904, p. 160.

Som few empty frustules of this coarsely areolated species were found in a sample from the outer part of the pack-ice in August 1906.

Distrib. Oceanic temperate species known from the plankton af the North Atlantic west of 26° W. Long., not at home in arctic water.

13. **Coscinodiscus curvatulus** Grun. var. **karianus** Cleve et Grunow, K. Svenska Vet. Akad. Handl., Bd. 17, No. 2, 1880, p. 113, pl. 7, fig. 129; *C. curvatulus*, var. *genuina* Grun., Diat. v. Franz Josefs Land, 1884, p. 31, ex parte, pl. D, fig. 13 (non fig. 14); *C. curvatulus* Gran, Nord. Plankton XIX, p. 35, ex parte, fig. 37 a.

In two samples from the pack-ice, taken in July 1908, I found rather sparingly a *Coscinodiscus* which agrees well with the form quoted above, var. *karianus* of *C. curvatulus*, and to this form I also refer the fig. 13 by Grunow's diatoms from Franz Josefs Land. It has a single row of distinct *apiculi*.

Gran has pointed out that probably several species are included in Grunow's *C. curvatulus*. He gives figures of a form from the Norwegian Sea which has no *apiculi* and in which the low girdle consists of the two connecting parts and a plain intercalary hoop. Our form has a somewhat higher girdle in which each connecting part has an intercalary hoop and the line between the connecting part and the intercalary part is elevated and with a V-shaped curvature, see fig. 5. I think that it is a distinct arctic species, but my material is too scanty to decide the question.

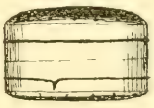

Fig. 5. *Coscinodiscus curvatulus* Grun., var. *karianus* Cl. & Grun.

Distrib. (of var. *karianus*): Arctic Sea, in pack-ice; (of the main species): widely distributed both in colder and warmer seas.

14. **Coscinodiscus Joergensenii** nom. nov.; *C. polyacanthus*, var. *intermedius* Grunow, Diat. v. Franz Josefs Land, p. 29, pl. C, fig. 25; Jørgensen, Bergens Museums Skrifter, 1905, p. 92; non *C. intermedius* Ehrbg.

In some samples from the pack-ice (July—August 1906 and 1908) and from Danmarks Havn (October 1906, August 1907) I have found rather scattered, specimens of a fasciculate *Coscinodiscus* of the *subtilis*-group, which agrees well with Grunow's quoted description and figure. As Jorgensen (l. c.) has suggested, it is distinct from the true *C. polyacanthus* Grun. by having one row of small interfasciculate apiculi and is closely related to *C. curvatulus* (at least to var. *karianus*) from which it differs e. g. by a finer structure and straight *fasciculi*. On the other hand it is allied to *Thalassiosira bioculata* from which it is easily recognised by having only one (not two) central areole and by a less fine structure. I have not succeeded in finding out the construction of the girdle exactly, but it has not the many intercalary connecting parts of *Th. bioculata* and the cells are not high.

My figures Fig. 6 will show the structure of the valves and the number of apiculi which is considerably lower than in *C. polyacanthus*.

GRUNOW (l. c.) gives the size to 60 μ, I have found it ranging from 50 til 80 μ.

In the samples from Danmarks Havn in October 1906 I found

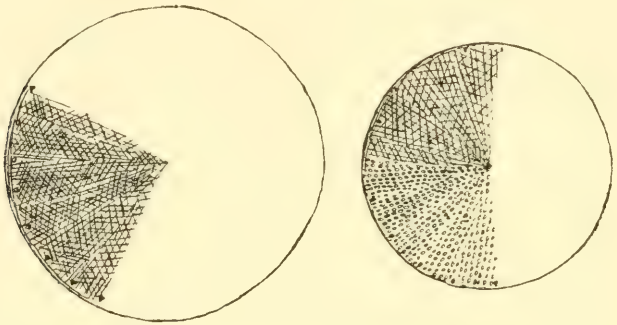

Fig. 6. *Coscinodiscus Joergensenii* n. nom. 500 t. m.

two specimens just coming from the auxospores and having one valve developed while the other half of the cell had the *perizonium* wall kept; and in the same samples I also found some globular bodies of just the same size and with the same contents of chromatophores, etc.; these globules I consider as the auxospores of this species. In the figures 7 I have given such a globule and the auxospore-cell at the same magnification. As the cells seem to live solitary, the mature auxospore — as in *C. subbuliens* — does not occur adherent to its mother-cell.

Fig. 7. Auxospore of *Coscinodiscus Joergensenii* n. nom.

Distrib. Probably arctic neritic species, known from Cape Wankarema (Grunow) and Arctic Norway (Jørgensen).

Note. It has been said many times before, but I cannot help repeating that the genus *Coscinodiscus* is in a great confusion and that the limits of the species are very indistinct. It is to be hoped that a monographer will be found who may have a happy hand to clear up this difficult matter.

Asteromphalus Ehrbg., 1844.

15. **Asteromphalus Hookeri** Ehrbg., Monatsber. Berlin. Akad. Wissensch., 1844, p. 200, fig. 3; Gran, Nord. Plankton, 1905, XIX, p. 45, fig. 50; *A. Brookei* Bail., var., Cleve Bih. K. Svenska Vet. Akad. Handl., Bd. 1, 1873, p. 10, pl. 4, fig. 19; *A. atlanticus* Cleve, Bih. K. Svenska Vet. Akad. Handl., Bd. 22, afd. 3, No. 4, 1896, p. 5; K. Svenska Vet. Akad. Handl. Bd. 34, No. 1, 1900, p. 19, pl. 8, figs. 7—9.

A single specimen was met with in a sample from the outer part of the pack-ice; August 1906.

Distrib. Northern-temperate, oceanic species, known from the North-Atlantic and the Antarctic.

Rhizosolenia (Ehrbg.) Brightw. 1858.

16. **Rhizosolenia styliformis** Brightw., Quart. Journ. Microsc. Science, VI, 1858, pl. V, fig. 5; Peragallo, in Le Diatomiste, vol. I, 1892, p. 111, pl. 4, figs. 1—5; Gran, Rep. Norweg. Marine- and Fishery-Investig., vol. 2, No. 5, 1902, pl. 1, figs. 1—9; Nord. Plankton, 1905, XIX, p. 54.

Found in Danmarks Havn (September—October 1906, August 1907) and in the coastal water (1906 and 1908), but nearly absent from the pack-ice. It occurs in most samples very rarely, but in a single one not uncommon.

Distrib. Widely distributed oceanic species, often character organism over large areas of water, mostly a temperate species, but here and in some other exceptional cases behaving as an arctic organism.

17. **Rhizosolenia hebetata** Bailey, American Journ. of Sc. and Arts, Ser. 2, vol. 22, 1856, pl. 1, figs. 18, 19; Cleve, Vega-Exp. vetensk. iakttag., Bd. 3, 1883, pl. 6, fig. 69; Gran, Fauna Arctica, Bd. 3, Lief. 3, 1904, p. 524; Nord. Plankton 1905, XIX, p. 55, fig. 67.

f. **semispina** (Hensen) Gran, l. c., p. 55; *Rh. semispina* Hensen, V. Ber. Komm. Unters. Deutschen Meere, 1887, p. 84, pl. 5, fig. 39.

Only found in the pack-ice and here — especially in August 1906 — the dominant species in some samples. In July—August 1908 not so common.

Only the f. *semispina* was seen.

Distrib. Northern oceanic species of wide distribution.

18. **Rhizosolenia obtusa** Hensen, V. Ber. Komm. Unters. Deutschen Meere, 1887, p. 86, pl. 5, fig. 41; Gran, Nord. Plankton XIX, p. 56; *R. alata*, var. *truncata* Gran, Norske Nordhavs Exp., Protophyta, 1897, p. 6, pl. 4, fig. 67.

Only found in the pack-ice and in the same samples where *R. hebetata*, f. *semispina* was present. Dominant in some samples from August 1906, not common in 1908.

Distrib. Northern oceanic species known from the colder parts of the North Atlantic and the Norwegian Sea, etc.

Eucampia Ehrbg., 1839.

19. **Eucampia groenlandica** Cleve, Bih. K. Svenska Vet. Akad. Handl., Bd. 12, afd. 3, No. 4, 1896, p. 10, pl. 2, fig. 10; Jørgensen, Bergens Museum Skrifter, 1905, p. 99, pl. 6, fig. 8; Gran, Nord. Plankton, XIX, 1905, p. 99, fig. 127.

Single chains were found in four samples of July 1908 from Danmarks Havn and the coastal water, not in the pack-ice.

In some cases the chains were like Gran's f. *atlantica* (fig. 127 d),

in others they stand intermediate and in others again they were typical (fig. 127 c); thus the f. *atlantica* has probably a very restricted value.

Distrib. Arctic neritic species; known from the coasts of arctic countries; also (rarely) found at Bohuslen, Scotland and in the Norwegian Sea.

Chætoceras Ehrbg., 1844.

20. **Chætoceras atlanticum** Cleve, Bih. K. Svenska Vet. Akad. Handl., Bd. I, No. 13, 1873, p. 11, pl. 2, fig. 8; Gran, Nord. Plankton, XIX, 1905, p. 64, fig. 74.

This species is found in several samples from Danmarks Havn, the coast water and the pack-ice, but always in single specimens. July—September 1906—1908.

Distrib. Widely distributed in the Atlantic Ocean and its tributaries, also in the Antarctic Ocean; oceanic species.

21. **Chætoceras convolutum** Castracane, Report of the Challenger Exp., Botany, II, 1886, p. 78; Gran, Fauna Arctica, III, Heft 3, 1904, p. 530, fig. 1; Nord. Plankton XIX, 1905, p. 69.

In the pack-ice this species was dominant in some samples from August 1906; in 1908 it was also present, but not in greater quantities. It was further found in samples from the coastal water and from Danmarks Havn, but only sporadically and in single specimens.

Distrib. Northern oceanic species, known from the North Atlantic and the Antarctic Oceans.

22. **Chætoceras criophilum** Castracane, Report of the Challenger Exp., Botany, II, 1886, p. 78; Gran, Fauna Arctica, III. Heft 3, 1904, p. 532, fig. 3; Nord. Plankton XIX, 1905, p. 71.

If we follow Gran (l. c.) in the distinctive marks between this and the foregoing species, i. e. *C. criophilum* has none or a very rudimentary connecting zone and *C. convolutum* a well developed one, it results that this species is very rare in the area, only some solitary specimens were found in two samples from the pack-ice, one in 1906 and one in 1908. It is rather unexpected that it is so rare, as it is one of the characteristic and dominant species of the sea between Iceland and Jan Mayen.

Distrib. Northern oceanic species, widely distributed in the northern parts of the Atlantic and its tributaries, further known from the Antarctic.

23. **Chætoceras boreale** Bailey, Smitsonian Contrib. to knowledge, vol. 7, 1854, p. 8, figs. 22—23; Gran, Fauna Arctic. III, Heft 3, 1904, p. 533, fig. 5, Nord. Plankton XIX, p. 73.

One of the most common species in the area. Both in 1906 and 1908 it was the dominant species in many samples from the

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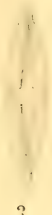

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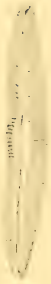

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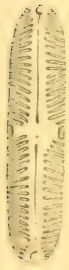

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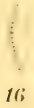

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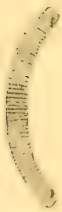

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coastal water and present also both in Danmarks Havn and in the inner border of the pack-ice. In August 1906 it was not uncommon at ca. 13° W. Long., and dominant in the samples taken along the coast from Koldewey Island to Cape Amélie; in October 1906 some specimens were found in Danmarks Havn, but mostly empty frustules. In August—September 1907 single specimens occurred in the samples from Danmarks Havn. In July 1908 it was dominant in Danmarks Havn and from that place northwards along the coast until ca. 78° N. Lat., and it was further found in some samples a little more eastwards, until ca. 11° W. Lat.

In some of the samples from August 1906 and July 1908 taken in the coastal water (the temperature of the water being between ÷ 0,5 and 4,2°) I often found chains in which the awns of many of the cell-walls had aborted. As the fig. 8 shows, such a chain gets a rather curious aspect: The two latest divisions of the chain figured have produced new cells which bear no awns from the valves while the oldest division has given normally developed awns of which only the bases have been drawn. At the places of the awns we find only small protuberances on the valves, and the protuberances of two cohering valves correspond to each other. It looks as if the cell-division has stopped too early, when only the division of the contents has been fulfilled and the development of the foramen has begun. In some cells I found very short and curved awns in stead of the protuberances, thus showing the reduction in a somewhat less degree.

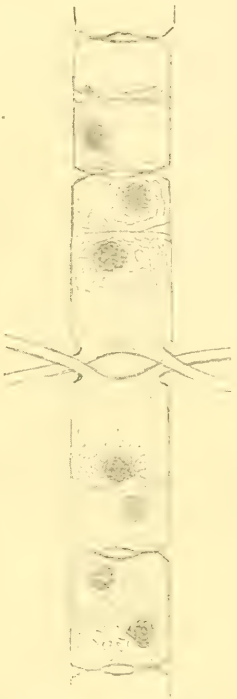


Fig. 8. *Chaetoceras boreale* Bail. with aborted awns. 500 t. m.

I have no real explanation of the phenomenon. Perhaps it shows that the cell-division takes place very rapidly, or perhaps it designates a state of hunger, or perhaps it has something to do with microspore formation, as it occurred in the some samples in which microspore formation in *Ch. decipiens* was observed (but no microspores were found in *Ch. boreale!*). K. Okamura (Bot. Magaz., Tokyo, XXI, 1907, pl. III, fig. 36) has figured the same phenomenon in a chain of *Ch. criophilum*, but has no remarks on it in the text, while in the explanation of the figures the says (p. 105): "One of the cells of another chain many times divided".

Also G. Karsten (Valdivia-Exp., Phytoplankton des antarkt. Mee-

res, 1905, p. 118, Pl. 15, figs. 8 d, e) has found *Ch. criophilum* in the antarctic ocean with aborted awns. He tells that the chains of this abnormal aspect occur in depths of 100—80 m. and supposes that the phenomenon is connected hereto: „Darin ist eine Minderung des Formwiderstandes gegeben . . . Diese Zellen resp. Zellreihen schweben dementsprechend in tieferen Wasserschichten; . . . .“ But this explanation does not hold good in our case where the abnormal chains occur in the surface layers of the water.

Distrib. Widely distributed species of northen Oceanic character, known from all Oceans.

24. **Chætoceras decipiens** Cleve, Bih. K. Svenska Vet. Akad. Handl., Bd. I, No. 13, 1873, p. 11, pl. 1, fig. 5; Gran, Norske Nordhavs-Exp., Protophyta. 1897, p. 13, pl. 1, figs. 2—3, pl. 3. fig. 34; Fauna Arctica, III, Heft 3, 1904, p. 535, pl. 17, figs. 1—6; Nord. Plankton XIX, p. 74, fig. 88.

As *C. boreale* one of the most common species in the area. It was rather rare in the pack-ice both in 1906 and in 1908, but dominant in both years in the whole series of samples from the coastal water (July—August) and in 1908 in Danmarks Havn. At the last named place it was also observed in October 1906, some of the frustules being empty, and in July--September 1907, but not in larger quantities. It seems thus as if the species has its real place of thriving in our area in the coastal water between the coast and the pack-ice. In a number of samples, especially in the samples from July 1908 the terminal awns had the peculiar structure which is characteristic for *C. Lorenzianum* Grun.; and also in the coarser awns from the other cells of the chains the structure was discernible, but more difficult to see. In other respects the specimens were quite typical, e. g. the awns being coherent at a part of their length, the terminal awns making the curvature at their proximal ends and then slightly divergent or nearly parallel. It is then not possible to refer our specimens to *C. Lorenzianum* Grun., nor to the arctic species *C. mitra* (Ehrbg.) Cleve. More probably a closer examination of the coarser specimens of *C. decipiens* from other regions will result in finding the same structure of the awns.

Besides this observation, another matter of some interest was found:

In two samples from August 1906 and in two from July 1908 I have found *microspore formation* in the cells. All these samples have been taken in the ice-filled coastal water north of 77° N. Lat. the temperature of the water being between ÷ 0,5° and 1,4°. The examination of this microspore development does not give much

new, as we have the excellent description and drawings of this processus in *Chæt. decipiens* by GRAN (1904). I have only to refer the reader to this paper and to GRAN's paper of 1902 (Rep. Norweg. Mar. Fish. Investig., vol. 2, No. 5) in which the microspore formation in *Rhizosolenia styliformis* was described and where considerations on the microspore problem in general were put down. Similar considerations embrazing all the known cases of microspore formation, are given by G. KARSTEN (Valdivia-Exp., Phytoplankton d. Atlant. Meeres, 1908).

The annexed figures (Fig. 9) show the different stages in the development of the microspores; they correspond rather closely to GRAN's figures (1904). In the left drawing we find a chain the end cell of which is a normal cell in rest and contains but one nucleus, while the two other cells have fulfilled the division of the nucleus into two daughter nuclei. It might be supposed that this stage could illustrate the beginning of an ordinary cell-division as well as the beginning of the microspore formation, but this is not right as there is a great difference which will be clear if we compare this drawing with the fig. 1 by GRAN (1904); this author gives here the corresponding stage of an ordinary cell-division, and his drawing shows that contemporaneously with the division of the nucleus a fissure in the plasma appears as the first beginning of the future foramen between two cells. This fissure does not exist in my case, whereby it is proved that we have here the first stage of microspore formation.

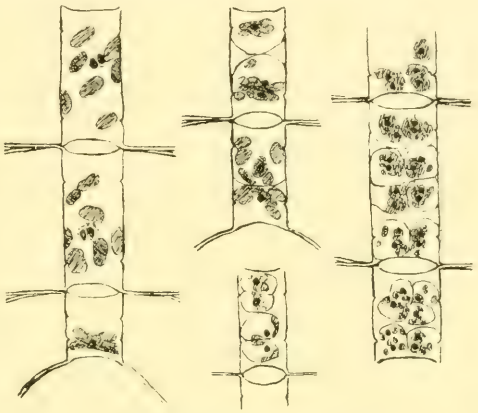


Fig. 9. *Chaetoceras decipiens* Cl. Cells in microspore-formation. 250 t. m.

The other figures show stages with 2, 4, 8 and 16 daughter nuclei corresponding rather well to the figures by GRAN, but his material has been better stained than mine. Perhaps we have herein the explanation of the following difference, viz.: that the division of the nuclei in my material goes on a good time before the division of the plasma, thus e. g. in the figure to the right we have 16 nuclei, but only (7—)8 plasma-lumps each containing 2 nuclei. With regard to the further fate of the microspores preserved material does not allow observations, and to the theoretical considerations set forth by GRAN, BERGON and KARSTEN I have nothing

to add. Only one new case of microspore formation has been discovered since Karsten's paper, viz. the microspore formation in *Chæt. Lorenzianum* Grun. found by J. Schiller (Ber. Deutsch. Bot. Ges., XXVII, 1909, p. 352) in the Gulf of Triest. The formation described corresponds rather well to the manner of sporulation found by Gran in *Chæt. decipiens* and by George Murray (Proc. Roy. Soc. Edinburgh, XXI, 1896, p. 207) in *Chæt. boreale*; as to the hypothesis advanced by the author on the cause of the rarity of microspores — viz.: that the microspore formation in most species should take place by the germination of the resting cysts —, I have only to say that it is a purely theoretical supposition, for which we have no basis as long as we do not know a single case of germination of a resting spore. It is a very remarkable fact that in spite of the numerous studies on the plankton diatoms during the last two decennia, nothing has been discovered with regard to this important matter. It is to be hoped that we may soon get this mystery solved.

Distrib. Oceanic species of a northern character, a dominant species over wide areas of the North Atlantic and its tributaries.

25. **Chætoceras diadema** (Ehrbg.) Gran, Norske Nordhavs Exp., Protophyta, 1897, p. 20, pl. 2, figs. 16—18; Nord. Plankton XIX, p. 84; *C. groenlandicum* Cleve, Bih. K. Svenska Vet. Akad. Handl., Bd. 22, afd. 2, No. 4, 1896, p. 7, pl. 2, figs. 3—5; *Syndendrium diadema* Ehrbg. Mikrogeologie, pl. 35, A, XVIII, 13.

Found sparingly in one sample (Aug. 1906) in the pack-ice, rather sparingly in some samples from the coastal water (July 1908) and not uncommon in samples from Danmarks Havn in August—September 1907 and here with resting spores.

Distrib. Northern neritic species of wide distribution.

26. **Chætoceras Wighami** Brightw., Quart. Journ. Microsc. Science, IV, 1856, p. 108, pl. 7, figs. 19—36; Gran, Nord. Plankton, XIX, 1905, p. 88; Ostenfeld, Wiss. Ergebn. Aralsee-Exp., Lief. VIII, St. Petersburg, 1908, p. 153, pl. 5, figs. 9—12; *C. bottnicum* Cleve in Aurivillius, Bih. K. Svenska Vet. Akad. Handl., Bd. 21, afd. 4, No. 8, 1896, p. 14, pl. 1.

Found rather sparingly in Aug.—Septm. 1907 in Danmarks Havn; rather often occurring in the coastal water in July 1908 and here common in a few samples; further single chains found in a sample from the pack-ice (July 1908).

Distrib. Euryhaline neritic species, known from the coasts of Europe and Arctic countries, further from the Caspian and Aral Seas.

27. **Chætoceras debile** Cleve, Bih. K. Svenska Vet. Akad. Handl., Bd. 20, afd. 3, No. 2, 1894, p. 13, pl. 1, fig. 2; Østrup, Medd. om Grøn-

land, XVIII, 1895, p. 456, pl. 7, fig. 89; Gran, Norske Nordhavs Exp., Protophyta, 1897, p. 23, pl. 2, figs. 14—15; Nord. Plankton XIX, 1905, p. 92.

Rare in the collection, only found in three samples from Danmarks Havn in Aug.—Septm. 1907, and, in a dwarfy state, in two samples from the pack-ice in July 1908.

Distrib. Northern neritic species, known from the coasts of Europe and Arctic countries, further from Japan.

28. **Chætoceras furcellatum** Bail., American Journ. of sc. & arts, ser. 2, vol. 22, 1856, pl. 1, fig. 4; Cleve u. Grunow, K. Svenska Vet. Akad. Handl., Bd. 17, No. 2, 1880, p. 120, pl. 7, figs. 136—137; Gran, Bibliotheca Botanica, Heft 42, 1897, p. 7, pl. 1, figs. 15—16; Nord. Plankton, XIX, 1905, p. 95.

Occurs as one of the characterizing species in a group of samples from the inner part of the pack-ice, in July 1908. Further some *Chætoceras*-chains in samples from Danmarks Havn in 1907 and in the coastal water in 1908 may perhaps be referred to this species, but the determination is not sure.

Distrib. Arctic neritic species, known from the Arctic Seas, reaching along the Norwegian coast as far southwards as Cape Stadt.

29. **Chætoceras sociale** Lauder, Transact. Microsc. Soc., vol. 12, N. S., 1864, p. 77, pl. 8, fig. 1; Cleve, Bih. K. Svenska Vet. Akad. Handl., Bd. 22, afd. 3, No. 4, 1896, p. 9, pl. 2, fig. 9; Gran, Nord. Plankton XIX, 1905, p. 96, fig. 123.

Occurs in great quantities in samples from Danmarks Havn in Aug.—Septm. 1907, and with resting spores. Further common in some samples from the coastal water in July 1908 and rare in others; also here mostly with resting spores.

Distrib. Northern neritic species known from the coasts of Europe, Iceland, Arctic countries and Hongkong.

30. **Chætoceras gracile** Schütt, Ber. Deutsch. bot. Ges., 1895, p. 42, pl. 5, fig. 13; vix Paulsen, Medd. Komm. Havundersøg., Plankton I, 3, 1905. København, p. 5, figs. 6—7; non Apstein, Wiss. Meeresunters., Abt. Kiel, N. F., Bd. 11, 1909, p. 135, fig. 1; *C. septentrionale* Cleve, Bih. K. Svenska Vet. Akad. Handl., Bd. 22, afd. 3, No. 4, 1896, p. 9, pl. 2, fig. 8; vix Østrup, Medd. Grønland, XVIII, 1895, p. 457, pl. 7, fig. 88.

In two samples from Danmarks Havn, August 1907, and in one sample from the coast water, July 1908, I found a small solitary *Chætoceras* with resting spores. As my figures (Fig. 10) show, it must be identified with Cleve's *C. septentrionale* from Baffin Bay, but hardly with Østrup's original species of that name. On the

other hand it is probable that *C gracile* Schütt is the same species, because if we compare Schütt's figures of cells with chromatophores with my fig. 10, we will find a close resemblance; on the contrary his figures of resting spores differ from mine, but he has not drawn these spores in situ within cells, and it is perhaps permitted to doubt, if they belong to the species in question.

Paulsen (l. c.) has given figures from Østrup's original material and considers his form as identical with Schütt's *C gracile*, but I

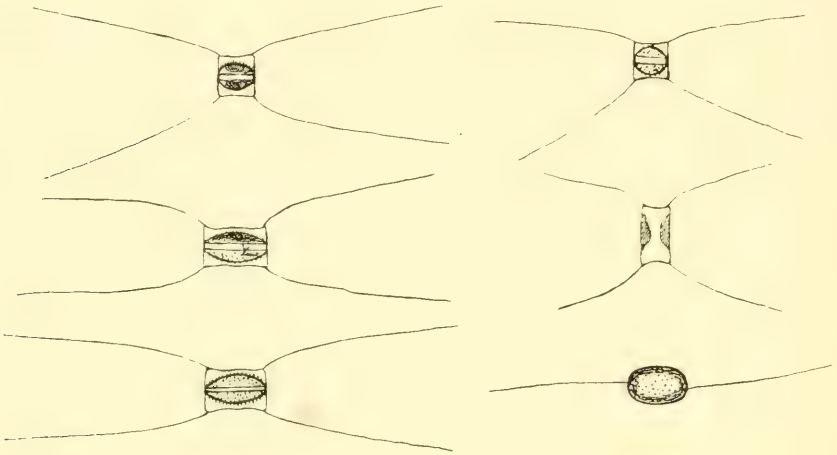


Fig. 10. *Chætoceras gracile* Schütt. 500 t. m.

doubt if he is right in doing so. The question is a much intricate one.

The latest note by Apstein about these small solitary species contains drawings of a species from the Baltic — the locality of Schütt's species — which the author names *C. gracile* but, I think, hardly correct; I myself know Apstein's form from the Belt Sea (Baltic) and have found it with resting spores which differ considerably from those of *C. gracile*; they have two rather large spines on the primary spore-valve (in the same manner as the spores of *C. debile*) and often also small spines, while the secondary valve is smooth. The species has only one chromatophore, as also drawn correctly by Apstein, and the corners of the cell in side view are not contracted; all these distinctive marks separate it from the true *C. gracile*, and I propose to name it *C. ceratosporum* nov. sp.; it is only known from the Baltic, where it occurs in the spring and seems to have its true home in the inner part, as I have seen it in samples kindly sent me by Dr. K. M. Levander of Helsingfors.

Anyhow the small solitary *Chætoceras* species require a revision,

as the treatement given by Lemmermann (Arkiv f. Botanik, Stockholm, Bd. 2, No. 2, 1904) is not a good one.

Distrib. (of *Ch. gracile. sens. lat.*): Euryhaline neritic species known from coasts of Greenland and Europe.

Biddulphia Gray, 1831.

31. **Biddulphia arctica** (Brigtw.) Boyer, Proc. Acad. of Nat. Sc., Philadelphia, 1900, p. 714; Gran, Nord. Plankton, XIX, 1905, p. 109, fig. 143; *B. balæna* Brightw., Quart. Journ. Microsc. Sc., vol. 8, 1859, p. 181, pl. 9, fig. 15; *Triceratium arcticum* Brightw.. ibid, vol. 1, 1853, p. 250, pl. 4, fig. 11.

Found sparingly in three samples from Danmarks Havn, Aug.—Septm. 1907.

Distrib. Littoral form (not true plankton form) from the Arctic coasts.

B. Pennatæ.

Fragilaria Lyngb., 1819.

32. **Fragilaria islandica** Grun. in V. Heurck, Synopsis, 1883, pl. 45, fig. 37; Jørgensen, Bergens Museums Skrifter 1905, p. 102, pl. 6, fig. 10; Gran. Nord. Plankton. XIX, 1905, p. 114, fig. 153.

Only found in Danmarks Havn, where it was present in the plankton, although only scattered, in all three years. July—October.

Distrib. Arctic neritic species, known from the coasts of the European Arctic sea; probably not a real plankton form.

33. **Fragilaria oceanica** Cleve, Bih. K. Svenska Vet. Akad. Handl., Bd. 1, No. 13, 1873, p. 22, pl. 4, fig. 25; Grunow, Diat. v. Franz Josefs Land. 1884, p. 55, pl. 2, fig. 14; Gran, Bibliotheca Botanica, Heft 42, 1897, p. 20, pl. 1, figs. 6—9; Nord. Plankton XIX, 1905, p. 114, figs. 154—155.

In 1906 only very few samples contained this species, and only in few specimens, while in 1907 and 1908 it was a dominant feature in July and August samples from Danmarks Havn and the coastal water. In the pack-ice it was not at home, recorded in few specimens from three samples (two in 1906 and one in 1907). July—October.

Several of the forms distinguished by Gran (1905) according to the curvature and twisting of the chains, were seen. In all samples from 1907 and 1908 resting spores were present, often in large quantities.

Distrib. Arctic neritic species known from Davis Strait and the Euopean Arctic Sea and a little more southwards.

34. **Fragilaria cylindrus** Grunow, Diat. v. Franz Josefs Land, 1884, p. 55, pl. 2, fig. 13; Gran, Bibliotheca Botanica, Heft 42, 1897, p. 20, pl. 1, figs. 4—5; Nord. Plankton, XIX, 1905, p. 115; Jørgensen, Bergens Museums Skrifter, 1905, p. 102, pl. 6, fig. 9.

This species resembles the foregoing one very much, and it is only possible to distinguish them when the ignified frustules are seen in valvar view. Hence it may be that some of the records of *F. oceanica* include this species of which I have seen sure specimens only in one sample from Danmarks Havn, July 1908.

Distrib. Arctic neritic species of about the same distribution as the foregoing, but often overseen.

Thalassiothrix Cleve et Grun., 1880.

35. **Thalassiothrix longissima** Cleve et Grun., K. Svenska Vet. Akad. Handl., Bd. 17, No. 2, 1880, p. 108; G. Karsten, Wiss. Meeresunters., Abt. Kiel, N. F., Bd. 4, 1899, p. 28, fig. 11; Gran, Nord. Plankton, XIX, 1905, p. 116; *Synedra thalassiothrix* Cleve, Bih. K. Svenska Vet. Akad. Handl., Bd. 1, No. 13, 1873, p. 22, pl. 4, fig. 24.

Only a single specimen found in a sample from the pack-ice in Aug. 1906.

Distrib. Northern oceanic species, often occurring in great quantities, e. g. in Denmark Strait and Irminger Sea.

Achnanthes Bory, 1822.

36. **Achnanthes tæniata** Grun. in Cleve et Grunow, K. Svenska Vet. Akad. Handl., Bd. 17, No. 2, 1880, p. 22, pl. 1, fig. 5; Gran, Bibliotheca Botanica, Heft 42, 1897, p. 9, pl. 1. fig. 10; Nord. Plankton, XIX, 1905, p. 122, fig. 165; Jørgensen, Bergens Museums Skrifter, 1905, p. 105, pl. 8, fig. 27.

As GRAN (1905, l. c., in nota) has pointed out, GRUNOW's and JØRGENSEN's figures represent chains with resting spores, while in GRAN's two quoted papers we find the normal vegetative chains.

Found in three samples from Danmarks Havn (Aug. 1907 and July 1908) and, with resting spores, in one sample from the pack-ice (July 1908). Perhaps overseen in other samples, as it resembles *Fragilaria oceanica* and *Navicula septentrionalis* very much.

Distrib. Arctic neritic species known from the Arctic Sea and the inner Baltic (in spring).

Navicula Bory, 1826.

37. **Navicula septentrionalis** (Grun.) Gran, Bibliotheca Botanica, 1897, Heft 42, p. 9; Nord. Plankton, XIX, 1905, p. 124, fig. 167; *Stauroneis septentrionalis* Grunow, Diat. v. Franz Josefs Land, 1884, p. 105,

pl. 1, fig. 48; Jørgensen, Bergens Museums Skrifter, 1905, p. 106, pl. 7, fig. 24; *Libellus (?) septentrionalis* Østrup, Medd. om Grønland, 1895, p. 439, pl. 8, fig. 97.

Found in some samples from Danmarks Havn and the coastal water, in 1906—1908, but scattered, and perhaps, as said under *Achnanthes*, sometimes not distinguished from the other band-like species.

Distrib. Arctic neritic species, known from the coasts of Greenland, from Barent and from Murman Sea.

38. **Navicula Vanhöffenii** Gran, Bibliotheca Botanica, Heft 42, 1897, p. 9, pl. 1, figs. 1—3; Nord. Plankton, XIX, 1905, p. 124; Jørgensen, Bergens Museums Skrifter, 1905, p. 105, pl. 7, fig. 22; *N. septentrionalis* Cleve, Bih. K. Svenska Vet. Akad. Handl., Bd. 22, afd. 3, No. 4, 1896, p. 11, non Østrup, nec Grunow.

Recorded from four samples from Danmarks Havn (Aug.—Septm. 1907, July 1908), but rare, and perhaps overseen.

Distrib. Arctic neritic species, known from the coast of Greenland and arctic Norway, from Barent and Murman Seas, further from the inner Baltic (in spring).

Amphiprora Ehrbg., 1843.

39. **Amphiprora hyperborea** (Grun.) Gran, Bibl. Botanica, Heft 42, 1897, p. 10; Fauna Arctica, III, 3, 1904, p. 543, pl. 17, fig. 14; Nord. Plankton, XIX, 1905, p. 127; *A. paludosa*, var.? *hyperborea* Grun. in Cleve et Grunow, K. Svenska Vet. Akad. Handl., Bd. 17, No. 2, 1880, p. 62, pl. 5, fig. 86.

In 1906 only found in one sample from the pack-ice and in 1907 in two samples from Danmarks Havn, in 1908 found scattered over the whole area from Danmarks Havn to the outer part of the pack-ice; always in few specimens. June—September.

Distrib. Arctic neritic species known from Greenland, arctic Norway, Barent and Murman Seas.

Nitzschia Hassall, 1845.

40. **Nitzschia frigida** Grun., in Cleve et Grunow, K. Svenska Vet. Akad. Handl., Bd. 17, No. 2, 1880, p. 94, pl. 5, fig. 101; Gran Bibl. botanica, Heft 42, 1897, p. 10, pl. 1, fig. 11; Nord. Plankton, XIX 1905, p. 129.

Found scattered in three samples from Danmarks Havn (Aug. 1907) and in three samples from the coastal water (Aug. 1906, July 1908).

Distrib. Arctic coast species, not true plankton form, known from the Arctic coast and the inner Baltic.

41. **Nitzschia seriata** Cleve, Vega Exp. vetensk. iaktt., Bd. 3, 1883, pl. 38, fig. 75; Gran, Nord. Plankton, XIX, 1905, p. 129, fig. 174; *N. fraudulenta* Cleve, 15. Ann. Rep. Fishery Board for Scotland, part III, 1897, p. 300, fig. 11; *Synedra Holsatiæ* Hensen, 5. Ber. Komm. Unters. Deutschen Meere, 1887, p. 91, pl. 5, fig. 50.

Only found in Danmarks Havn (Aug. 1907, July 1908) in four samples, but mostly rare.

Distrib. Widely distributed in open seas and along the coasts, probably a neritic species of northern, but not arctic character.

42. **Nitzschia delicatissima** Cleve, A Treatise of Phytoplankton, 1897, p. 24, pl. 2, fig. 22; Gran, Nord. Plankton, XIX, 1905, p. 130.

Found together with the preceding species in two samples from Danmarks Havn, Aug. 1907.

Distrib. Much like the preceding, but more restricted.

Nitzschiella Rabenh., 1864.

43. **Nitzschiella closterium** (Ehrbg.) Rabenh., Fl. Europ. Algar., I, 1864, p. 163; *Ceratoneis closterium* Ehrbg., Kreidethierchen, 1840, p. 64, pl. 4, fig. 7; *Nitzschia closterium* W. Smith, Syn. British Diatoms I, p. 42, pl. 15, fig. 120; Gran, Nord. Plankton, XIX, 1905, p. 129, fig. 172.

Found together with the preceding in two samples from Danmarks Havn (Aug. 1907) and further in one sample from the coastal water (July 1908); a littoral species which sometimes occurs in plankton as it often inhabits mucilage of other organisms.

Distrib. Ubiquitous along the coasts.

II. Flagellatæ.

A. Chrysomonadineæ.

Dinobryon Ehrbg., 1838.

1. **Dinobryon pellucidum** Levander, Acta Soc. Fauna & Flora Fenn., 12, No. 2, 1894, p. 31, pl. 2, fig. 1; *Dinodendron balticum* Schütt; *Dinobryon b.* Lemmermann, Ber. Deutsch. bot. Ges., 1900, p. 514, pl. 18, figs. 9—10; Nord. Plankton, XXI, p. 4, figs. 13—14.

Single specimens occurred in a sample from Danmarks Havn in 1906, but besides that the species was distributed in the outer parts of the pack-ice, east of ca. 12° W. Long., in some samples it was common, especially in 1908 (in 1906 found only in two samples). When the temperature rose above 7° and the salinity over 34 ‰ it disappeared. July—August.

Distrib. A boreal neritic species, known from the coastal waters of Greenland, Iceland, Spitsbergen, Norway, Færöes and the Baltic.

Phæocystis Lagerheim, 1893.

2. **Phæocystis Pouchetii** (Hariot) Lagerh., Botan. Notiser, 1893, p. 32; Öfv. K. Sv. Vet. Akad. Förhandl., 1896, p. 277, figs. 1—5; Ostenfeld, Arch. f. Protistenkunde, III, 1904, p. 295, fig. 1.

Found scattered over the area, in two samples of 1908 rather common, but not in great quantities, probably because the season has been too late. Not seen in the samples taken in Danmarks Havn, but only recorded from the coastal water and the pack-ice. July—August.

Distrib. A boreal-arctic neritic species which often plays a conspicuous part in the plankton, f. i. in Davis and Denmark Straits, around Iceland, off northern Norway, etc.

B. Coccolithophoridæ.

Coccolithophora Lohmann, 1902.

3. **Coccolithophora pelagica** (Wallich) Lohmann, Arch. f. Protistenkunde, I, 1902, p. 138; *Coccosphæra p.* Wallich, Ann. Mag. Nat.

Hist., 1877, p. 348, pl. 17; Murray and Blackman, Trans. Roy. Soc., London, Ser. B, 1898, vol. 190, p. 439, pl. 16, figs. 6—10; *C. atlantica* Ostenfeld, Zool. Anzeiger, 22, 1899, p. 436, fig. 1.

Is was rather surprising to find a *Coccolithophora* in the plankton from such high latitudes and in such arctic water. It was seen in 1905 in three samples from outside the pack-ice and in 1908 in three samples also outside the pack-ice, but a little more southwards; in two of the latter ones it was rather common, especially in lumps of mucilage. It did not occur in any of the samples west of 11° W. Long. On closer examination it appeared that all the specimens examined were dead, as no nucleus nor chromatophores, etc., were present. July—August.

Disrib. A temperate oceanic organism, very distributed and common in the Atlantic Ocean.

Pontosphæra Lohmann, 1902.

4. **Pontosphæra borealis** nov. sp. *Cellulæ solitariæ globosæ, 17—22 μ; coccolithi elliptici, 3—4 μ longi, plani vel leviter concavi, omnes similes; flagella et chromatophori in spec. preservatis non distincti; nucleus adest.* Fig. 11.

In seven samples (three from 1908 and four from 1906) from the outer part of the pack-ice and outside it (i. e. not W. of 11° W. Long.) I found an interesting organism, viz.: a species of the genus *Pontosphæra*. As mentioned above the occurrence of *Coccolithophoridæ* in arctic water was a new thing, but the *Coccolithophora* present was dead. It is another matter with the *Pontosphæra*, as its plasma showed that the cells most probably were living when caught. It is then the first record of a species of *Coccolithophoridæ* living in arctic water. The species found must be referred to the genus *Pontophæra*, as it is understood by H. Lohmann, but I can not identify it with the species hitherto described (Lohmann, l. c., p. 129—332). The cells are mostly globose, rarely of a more oblong form, the coccoliths are plane or slightly concave, all of the same shape, elliptic and lying closely together, covering the whole surface of the cell. As only preserved material was examined no flagella were found, and it was not possible to discover chromatophores, whereas a nucleus was seen. By using acids the coccoliths disappeared immediately.

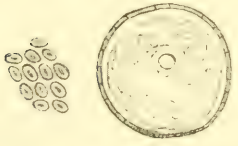


Fig. 11. *Pontosphæra borealis* n. sp. 800 t. m.

The new species resembles *P. inermis* Lohm., but has not the distinct naked pole ("Geisselpol") for the flagella. July—August.

In most of the samples it occurred together with *Cocc. pelagica*, but it did not occur in greater quantities, perhaps because it is so small that it is only in a small part caught by the nets.

C. Silicoflagellatæ.

Distephanus Stöhr, 1880.

5. **Distephanus speculum** (Ehrbg.) Haeckel, Challenger Rep., Radiolaria, 1889, p. 1560; Lemmermann, Ber. Deutsch. bot. Ges., 1901, p. 263, pl. XI, figs.; Nord. Plankton, XXI, p. 31, figs. 103—104.

Most of the specimens found in the samples must be referred to var. *septenarius* (Ehbg.) Jørg., f. *regularis* Lemm., l. c., fig. 104.

Found scattered over the area; in 1907 in three samples from Danmarks Havn, in 1908 also in the coastal water, and in 1906 in three samples in the outer part of the pack-ice. As the specimens examined had plasma, they must have been living when caught.

Distrib. (of the form) Karajakfjord in West-Greenland, Baltic; (of the species) oceanic species of worldwide occurrence, but hardly arctic.

Appendix: Pterospermataceæ.

Pterosperma Pouchet, 1894.

Pterosperma Vanhöffenii (Jørg.) Ostenfeld, Vidensk. Medd. Naturh. For., København 1901, p. 151; *Pterosphæra V.* Jørgensen; *Pterocystis V.* Lohmann, Eier u. sogen. Cysten der Plankton-Expedition, 1904, p. 44, pl. 7, fig. 10.

Single specimens found in several samples (10) in 1908, both near the coast (in Danmarks Havn) and in the outer part of the pack-ice. At least some of the specimens were empty. July—August.

Distrib. A temperate oceanic organism, known especially from the North Atlantic.

XI.

MARINE PLANKTON

FROM

THE EAST-GREENLAND SEA

(W. OF 6° W. LONG. AND N. OF 73° 30′ N. LAT.)

COLLECTED DURING THE "DANMARK EXPEDITION" 1906—1908

II. PROTOZOA

BY

C. H. OSTENFELD

1910

INTRODUCTION

The present paper is based upon the examination of a number of plankton samples collected during the "Danmark Expedition" to N. E.-Greenland 1906—1908. The samples have been collected by means of fine-meshed tow-nets and are all surface samples.

In the introduction to another paper on the Diatoms and Flagellates of the same samples I have rendered, more in details, an account of the data concerning the collection, etc. It will therefore, I think, be sufficient to repeat here the more important data.

The samples examined originate all from more or less ice-filled water which may be divided into three areas:

1°. Samples taken in the pack-ice (drift-ice) in August 1906 and July 1908. The geographical area is about 73° 30′—76° N. Lat. and 6°—13° W. Long.

2°. Samples taken in the coastal water west of the pack-ice and east of the coast of Greenland, between 76°—78° N. Lat.; August 1906 and July 1908.

3°. Samples taken in Danmarks Havn, Germania Land, 76° 46′ N. Lat., 18° 43′ W. Long., during the stay of the Expedition from the autumn of 1906 to July 21st 1908.

As already pointed out in my above mentioned paper, the samples from the last area are of greatest interest, but unfortunately it has not been possible for the Expedition to take samples during the whole time of the stay, at regular short intervals. There are only a few samples from October 1906, circa 10 from June—September 1907 and a couple from July 1908 when the steamer left the harbour.

From the opposite coast of Greenland, the west coast, we have Vanhöffen's valuable regular collection of the plankton of Karajak Fjord, ca. 70° N. Lat., upon which K. Brandt (1896) has based his interesting paper on arctic *Tintinnodea*. It is but natural that the samples from these two points on the coasts of Greenland are to be compared; and the following list will show a close resem-

blance between them. Almost the same species of *Tintinnodea* occur in both places, but it is remarkable that three species of *Tintinnopsis* (viz.: *T. nitida* Bdt., *T. sinuata* Bdt. and *T. sacculus* Bdt.) described by BRANDT from the Karajak Fjord, have not been seen in our samples; perhaps the more northern latitude of Danmarks Havn (6—7° higher) and the thereof resulting more strictly arctic conditions of life may have some relation to the absence.

Besides the *Tintinnodea* which are best taken by means of surface hauls with fine-meshed nets, the samples contain but few *Protozoa*, viz.: two *Radiolaria*, one *Foraminifera* and the resting stage of an unknown organism.

The *Radiolaria* have, taken in general, not their home in the surface water, and, no doubt, vertical hauls would have given many more species. *Globigerina bulloides*, one of the few pelagic Foraminifera, is an atlantic organism. Lastly we have the peculiar resting stage, HENSEN's "Sternhaarstatoblast" which has hitherto been known only from the Baltic and the occurrence of which consequently is of some zoogeographical interest. Nothing is known on its place in the system, and it may perhaps be a stage of some Metazoon.

In the following papers remarks on the species mentioned in the list and on their occurrence in the East-Greenland Sea are to be found:

BRANDT, K.: Die Tintinnen, in Zoologische Ergebn. d. von d. Ges. für Erdkunde zu Berlin unter Leitung Dr. von Drygalski's ausges. Grönlandexp. nach Vanhöffen's Sammlungen bearbeitet. — Bibl. Zoologica, Heft 20, 1896.

—: Die Tintinnodeen der Plankton-Expedition. Atlas u. Tafelerklärungen 1906; Systematischer Teil 1907.

CLEVE, P. T.: Plankton coll. by the Swedish Exp. to Spitsbergen in 1898. — K. Svenska Vet. Akad. Handl., Bd. 32, No. 3, 1899.

—: Report on the Plankton coll. by the Swedish Exp. to Greenland in 1899. — Ibidem, Bd. 34, No. 3, 1900.

DAMAS, D. et KOEFOED, E.: Le Plankton de la Mer du Grönland, in: Duc d'Orléans: Croisière Océanographique accomplie à bord de La Belgica dans la Mer du Grönland 1905. Bruxelles 1909.

JØRGENSEN, E.: Ueber die Tintinnodeen der norwegischen Westküste. — Bergens Museums Aarbog 1899, No. II, 1899.

—: Protophyten und Protozoën im Plankton aus der norwegischen Westküste. — Ibid.. No. VI, 1900.

—: Protistenplankton aus dem Nordmeere in den Jahren 1897—1900. — Ibid., 1900, No. VI, 1901.

—: Protistplankton, in: O. Nordgaard: Hydrographical and biological Investigations in Norwegian Fiords. — Bergens Museums Skrifter, 1905.

HENSEN, V.: Über die Bestimmung des Planktons. — 5. Bericht der Kommission zur wissenschaftlichen Untersuchung der deutschen Meere in Kiel für die Jahre 1882—86. Kiel 1887.

POPOFSKY, A.: Die nordischen Acantharien. — In: K. Brandt u. C. Apstein: Nordisches Plankton, Kiel u. Leipzig. 3. Lief. 1905.

I. Tintinnodea.

In the list of species given beneath I follow BRANDT's large work of 1907 where we find nearly all our knowledge concerning the systematical matters of this group of Infusorians put down.

Tintinnopsis Stein, 1867.

1. **Tintinnopsis karajacensis** Brandt, 1896, p. 57, pl. 3, fig. 5; 1906—07, p. 162, pl. 19, figs. 5, 7, 10—12, pl. 26, fig. 3, (varr.) pl. 19, figs. 1—2, 9, 19, 20, pl. 26, fig. 9; H. Laackmann, Wiss. Meeresunters., Bd. 10, Abt. Kiel, 1906, p. 21, pl. 1, figs. 12—14.

Nov. var. **lagenoides** (Fig. 1).

Differs from the main species in the inflated lower end of the house and in the scarceness of foreign bodies upon its wall.

In three samples (August—Septm. 1907) from Danmarks Havn I found rather sparsely a *Tintinnopsis* form which has caused me much trouble. It stands in many respects between *T. karajacensis* Bdt. and *T. sacculus* Bdt., but as I had not been able to find the peculiar structure of the "Primärwaben" characterizing *T. sacculus* (see BRANDT 1907, p. 164), I prefer to keep my form under *T. karajacensis*. From this it differs in the inflated lower end of the house and the distinct neck. The foreign bodies are small and rather few. I have not seen more than one nucleus.

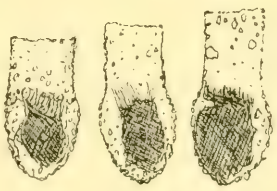


Fig. 1. *Tintinnopsis karajacensis* Brandt *var. lagenoides* n. var. 250 t. m.

The dimensions are as follows:

Length	80—88 μ,
Breadth of the neck	32 μ,
— of the lower part	40 μ.

It seems related to the var. *b* from Tocantin figured by BRANDT 1906, and perhaps to LAACKMANN's *T. Lohmanni* (l. c., p. 20, pl. 1, figs. 10—11).

Distrib.: (main species) Karajak Fjord, Davis Strait; Kiel Fjord; Norwegian Fjords; off Helder; (varr.) off Borneo; Tocantin; off Bombay; Iceland.

2. **Tintinnopsis? pellucida** (Cleve) Brandt, 1906, p. 18, 1907, p. 172, pl. 23, figs. 8, 14, 15; *Tintinnus* (?) *pellucidus* Cleve, 1899, p. 24, pl. 1, fig. 4; *T. bottnicus* Brandt, 1896, p. 53, pl. 3, fig. 11; *Leprotintinnus bottnicus* Jørgensen, 1899, p. 10; 1900, pl. 2, fig. 3; *L. pellucidus* Jørgensen, 1901, p. 18. (Fig. 2).

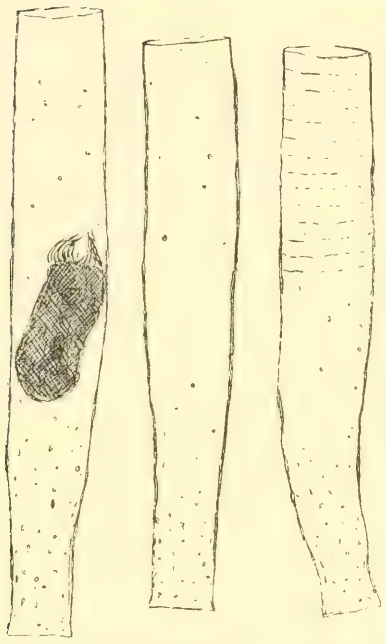


Fig. 2. *Tintinnopsis pellucida* (Cleve) Brandt. 250 t. m.

In one sample from September 1907 from Danmarks Havn and in two July-samples from the pack-ice *T. pellucida* was present, but rather rare. The annexed figures show the variability of the houses: rings are present or not, the lower part is straight or faintly curved, the foreign bodies are more os less abundant, etc.

The contracted animal figured in the left figure had two distint nuclei.

Length of the houses 330—344 μ (Brandt 0,2—0,27 mm.) Breadth 32 and 48 μ (narrowest and largest part).

Distrib.: Karajak Fjord; Davis Strait; N. and W. of Spitsbergen; Norwegian Coast off Bergen.

Cyttarocylis Fol, 1881.

3. **Cyttarocylis pseudannulata** Jørgensen, 1901, p. 15, pl. 2, fig. 28: Brandt 1906—07, p. 269, pl. 28, fig. 8, pl. 29, fig. 1; *C. annulata* Jørgensen, 1899, p. 36.

Only found in few specimens in a single sample from the pack-ice in August 1006.

Distrib.: Irminger Sea; N. E. of Jan Mayen; Norwegian West-coast.

4. **Cyttarocylis denticulata** Ehrbg., Jørg. emend.; Jørgensen 1899, p. 31, pl. 2, figs. 13, 15; 1901, p. 12, pl. 3, figs. 25—26; 1905, p. 144; Brandt 1906—07, p. 232, pl. 37, figs. 9—10, 15—17; non *C. denticulata* Brandt 1896, p. 62, nec Ostenfeld, in M. Knudsen & C. Ostenfeld, Iagttagelser over Overfladevandets Temperatur, Saltholdighed og Plankton paa islandske og grønlandske Skibsrouter i 1898, København 1899, p. 62.

The forms belonging to the group *C. denticulata* are of great importance for the plankton of the area here treated of. When we

follow JØRGENSEN (l. c.) and BRANDT's latest paper (1906—07), we have the following three "varieties" in the samples, all neritic varieties.

a. var. **typica** Jørg., 1899, p. 31, etc. (Fig. 3). This variety shows

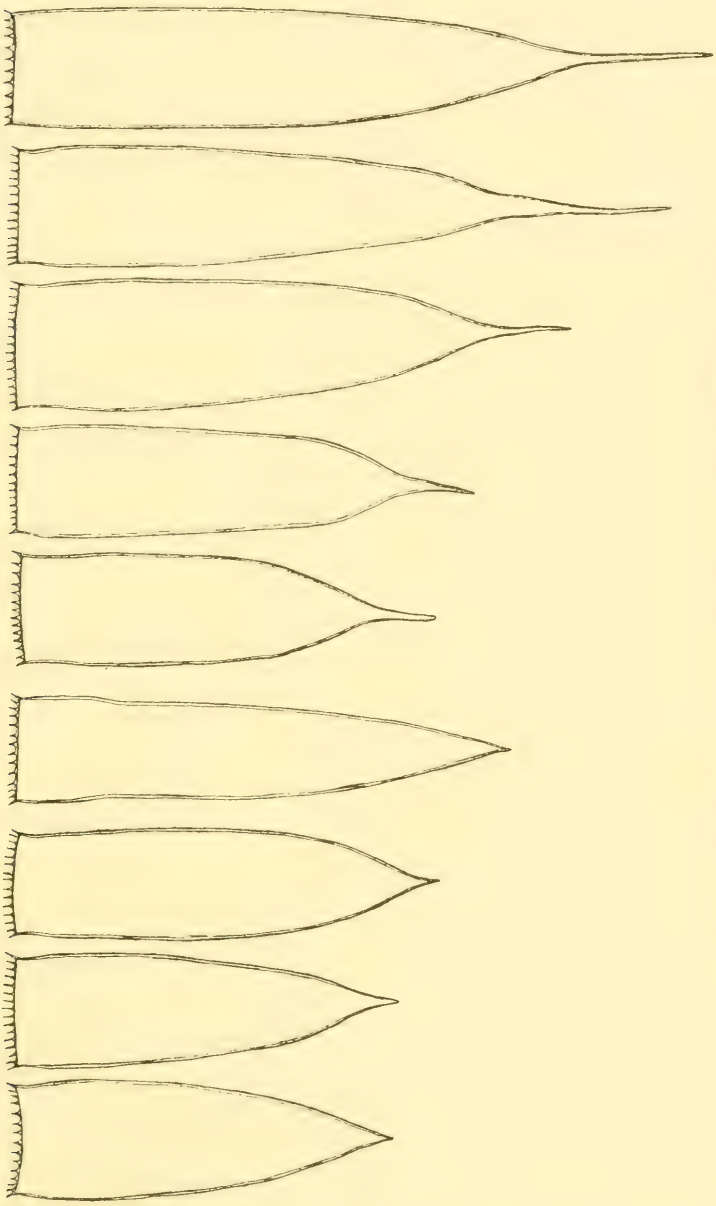


Fig. 3. *Cyttarocylis denticulata* Ehrbg. var. *typica* Jørg. 250 t. m.

a great variability; all the specimens given in the fig. 3 are from one sample (Danmarks Havn, Aug. 15th 1907) with exception of the

largest one (placed most at right). It we compare the specimens with the figures quoted above from JORGENSEN's and BRANDT's papers, we shall find a close resemblance. The smaller specimens answer to JØRGENSEN's f. *acuta* (1901, p. 12), the larger ones to his f. *caudata* (1901. p. 12), but I have not succeeded in finding any definite limit between them.

All the specimens which I reckon to the var. *typica* have in common: long and well-developed teeth in the mouth of the house, the lower end not sharply set off from the main part, but of variable length and often forming a distinct "Fortsatz"; the structure of the house-wall is not coarse.

Var. *typica* was dominant in the samples from the pack-ice in August 1906, but not present in the coastal water. It was found sparingly in the samples from Danmarks Havn in October 1906 (under the ice), but mostly only empty houses. In 1907 it was dominant in Danmarks Havn in Aug.—September. In July—August 1908 it occurred sparingly in the samples from the coastal water, while dominant in those from the pack-ice and again rare outside this, when the temp. rose from 0°—2° C. to 6°—7°. In the last region where I found it with resting spores (cfr. LAACKMANN, Wiss. Meeresunters., Abt. Kiel, 1906), the specimens were small and approached the oceanic species *C. edentata* Bdt. (f. *parumdentata* Bdt.).

The dimensions of the houses of some of the measured specimens follow here:

Length	Breadth	Length	Breadth
265 μ	85 μ	320 μ	75 μ
300 -	80 -	384 -	84 -
305 -	80 -	416 -	84 -
312 -	80 -	440 -	75 -

b. var. **gigantea** (Bdt.) Jørgensen, 1899, p. 35, pl. 3, figs. 26—28; 1901, p. 14; Brandt, 1906—07, p. 233, pl. 38, figs. 2, 3, 8, 9; *C. gigantea* Brandt, 1896, p. 63, pl. 3, figs. 21—24; Ostenfeld, l. c., 1899, p. 62. (Fig. 4).

In the samples from Danmarks Havn, Sept. 1907, I found together with the preceding form a still larger one, which agrees well with var. *gigantea*. It differed from var. *typica* in its greater length and the short teeth in the mouth of the house; the structure of the house-wall was the same.

Besides in the two mentioned samples, it was found very sparingly in July 1908 in and off Danmarks Havn (two samples) and in the pack-ice (two samples). It was not always easy to distinguish it from var. *typica*.

Dimensions (in μ): Length and Breadth 615 × 78 and 650 × 80.

c. var. **robusta** Jørgensen, 1901, p. 13, pl. 3, fig. 22; 1905, p. 144; Brandt, 1906–07, p. 234, pl. 38, figs. 4, 10. (Fig. 5).

In many samples where var. *typica* was present, another probably well-distinguished form also was found. It had about the same size as that, but differed in the rather sharply set-of "Fortsatz", the small and broad teeth of the mouth and in the much coarser wall of the house-wall. The latter character was very easily seen under low power of magnification as the transparence of the wall was quite another. No doubt it is the var. *robusta* of JØRGENSEN (l. c.), as my fig. 5 will prove. Sometimes specimens were found which had not the well-developed "Fortsatz", but elsewhere agreed with the var. *robusta*; these may be named f. *subrotundata* Jørg. (1899, p. 34, pl. 2, figs. 20—21, pl. 3, figs. 22, 25, 29; Brandt, 1906—07, p. 235, pl. 37, figs. 12—14), which I subordinate under var. *robusta*.

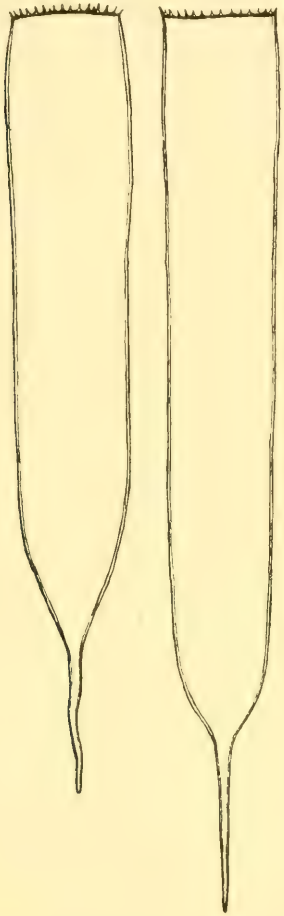


Fig. 4. *Cyttarocylis denticulata* Ehrbg. var. *gigantea* (Bdt.) Jørg. 250 t. m.

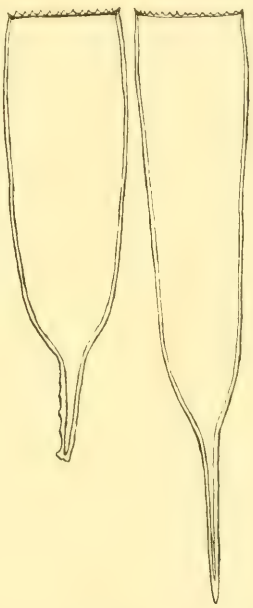


Fig. 5. *Cyttarocylis denticulata* Ehrbg. var. *robusta* Jørg. 250 t. m.

The variety was dominant, together with var. *typica*, in the

samples from the pack-ice in August 1906 and disappeared together with it when reaching the coastal water, but more slowly (the empty houses are perhaps more persistent than those of var. *typica*). It was present together with var. *typica* in Aug.—Sept. 1907 in Danmarks Havn, but not common. In 1908 (July—August) it was not present in the coastal water, but appeared in the pack-ice (probably only empty houses) and became common in the samples from the outer margin of and outside the ice.

Dimensions (in μ): 325×80, 420×80.

Distrib. (of *C. denticulata*): Neritic northern species of wide distribution, known along the coasts from New Foundland north- and eastwards to the Baltic Sea.

Ptychocylis Brandt, 1886.

5. **Ptychocylis obtusa** Brandt, 1896, p. 59, pl. 3, figs. 13, 15; 1906—07, p. 310, pl. 57, fig. 8; *P. urnula*, var. *obtusa* Jørgensen, 1901, p. 18, pl. 3, fig. 32; *P. Drygalskyi* Brandt, 1896, p. 59, pl. 3, fig. 14; *P. obtusa*, var. *Drygalskyi* Bdt., 1906–07, p. 312, pl. 55, figs. 1–3; pl. 56, figs. 3, 4; pl. 57, fig. 10; *P. urnula* var. *digitalis*, Jørgensen 1901, p. 17, pl. 2, figs. 29, 30, pl. 3, fig. 31; 1905, p. 143. (Fig. 6).

In samples from Danmarks Havn, Aug.—Septm. 1907, *P. obtusa* was found in some numbers, but not common; further it was present in July 1908 in some samples from the coastal water and here not so uncommon. It was with some hesitation that I named all the specimens examined *P. obtusa*, as at least the smaller ones also may be named var. *Drygalskyi*, but it has been impossible to me to find any distinct boundary between the main species and the so-called variety. To me it seems, as if var. *Drygalskyi* is only the smaller individuals of *P. obtusa*; and the annexed sketchs will show my meaning. Therefore I name them all *P. obtusa*.

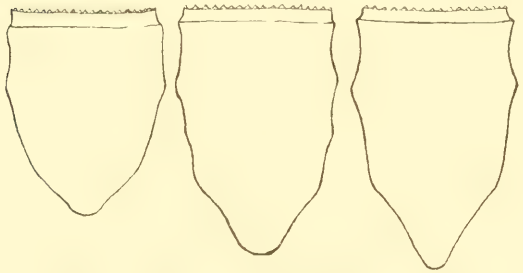


Fig. 6. *Ptychocylis obtusa* Brandt. 250 t. m.

Distrib. Arctic neritic species known from Davis Strait, Labrador Stream, Norwegian Sea, Norway, Spitsbergen.

6. **Ptychocylis urnula** (Clap. & Lachm.) Bdt., var. **acuta** Brandt, 1906, p. 28, pl. 56, figs. 1, 2, 6; pl. 57, fig. 7; *P. acuta* Brandt, 1896, p. 59, pl. 3, fig. 16.

In two samples from the outer part of the pack-ice in August 1906 a few specimens of a *Ptychocylis* were observed which I refer

to the arctic variety of *P. urnula* characterized (in spite of its name) by a less acute lower end of the house and smaller size. It forms a transition to the above mentioned species.

Distrib. (of var. *acuta*) Davis Strait; (main species) northern oceanic species.

Tintinnus Schrank, 1803.

7. **Tintinnus acuminatus** Clap. & Lachm., var. **secatus** Brandt, 1906, p. 32, pl. 66, fig. 5; 1907, p. 389; *T. secatus* Brandt, 1896, p. 51, pl. 3, fig. 12.

Only found once in a sample from the outer part of the pack-ice (Aug. 1906).

Distrib. (of var. *secatus*) Karajak Fjord, Davis Strait, Labrador Stream; (main species) northern oceanic species of wide distribution.

8. **Tintinnus norvegicus** (Daday) Brandt, var. **gracilis** Brandt, 1906, p. 30, pl. 62, figs. 2, 7; 1907, p. 407; *T. gracilis* Brandt, 1896, p. 54, pl. 3, fig. 7.

The form of the group *T. norvegicus* present in the area has the cylindrical shape of the house and the well-developed teeth of the mouth, characterizing Brandt's *T. gracilis*.

It was found in the samples from the pack-ice in August 1906 and in July 1908 and further outside the ice in August 1908; it was always rather rare, but because of its small size it is only to a small degree kept by the nets.

Distrib. (of the var. *gracilis*): Karajak Fjord, Davis Strait; (of the main species) Davis Strait, Labrador Stream, North Atlantic, off Bergen.

9. **Tintinnus vitreus** Brandt, 1896, p. 54, pl. 3, figs. 8—9; 1906—07, p. 438, pl. 66, fig. 7. (Fig. 7).

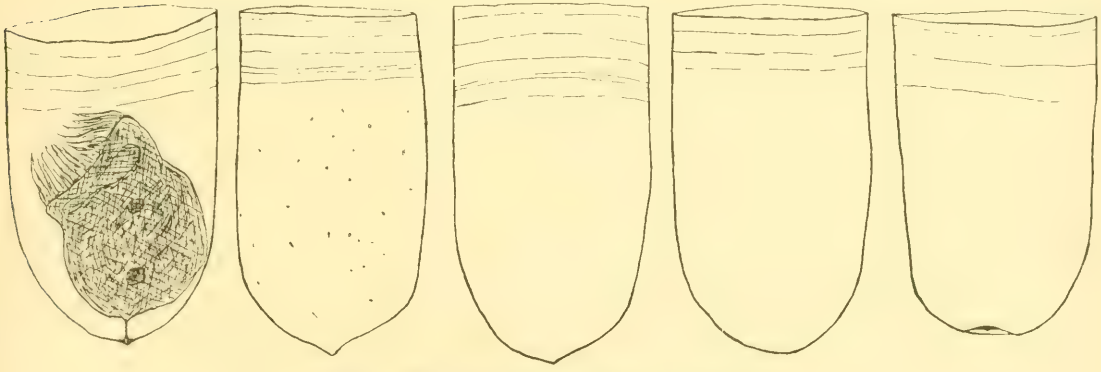


Fig. 7. *Tintinnus vitreus* Brandt. 250 t. m.

In his paper on the *Tintinnodea* from Vanhöffen's material from Karajak Fjord Brandt has described a rare *Tintinnus* which

has not been seen since then. This species I have found not rarely in a single sample from Danmarks Havn, Aug. 15th 1907, and I have been able to study it a little more in details. A single specimen was further found in a sample from the coastal water off Cape Amelie in Aug. 1906.

My specimens differ in some points from BRANDT's description, but I think it correct to retain them under his species. The houses are 210—240 μ long (BRANDT gives 0,14—0,15 mm.) and 120—140 μ broad. The lower end has mostly a small tip, more rarely it is rounded as in BRANDT's figure; and near the mouth a varying number of rings are seen, but they are very fine and often difficult to observe. The wall of the cylindrical house is hyaline and with high power of magnification the fine "Primärwaben" are discernible; sometimes very small foreign bodies are sparingly fixed upon the wall. The animal itself has two nuclei and a large vacuole; it is adherent to the innerside of the tip of the house by means of a stalk, — as far as preserved material (in alcohol) allows to judge.

The species seems to have a very short time of plankton life; it was present in Danmarks Havn in one sample from Aug. 15, but not in samples from Aug. 4th or 24th of 1907, and further in one sample from Aug. 15th 1906; temperature of the water was + 0,4° and ÷ 0,4° C. respectively.

Distrib. Arctic neritic species, hitherto only known from Karajak Fjord (March) and in our area (August).

II. Radiolaria.

As said above (p. 290), surface samples are not suitable for Radiolarians, and besides arctic waters have few species; it is then but natural that very few forms were seen in the collection.

A. Acanthometrida.

In three samples from the autumn 1907 from Danmarks Havn and in five samples from the coast water in July 1908 undetermined forms of *Acanthometrida* were seen. As far as I could find, the transverse section of the spines was quadrangular and no basal wing-cross was developed; it may then have been a species of *Acanthonia*, most probably *A. ligurina* Hæckel (cfr. Popofsky 1905).

B. Nassellaria, Dicyrtida.

Amphimelissa Jørg., 1905.

Amphimelissa setosa (Cleve) Jørgensen, 1905, p. 137, pl. 18, fig. 109; *Botryopyle setosa* Cleve, 1899, p. 27, pl. 1, fig. 10.

Two specimens of the group *Dicyrtida* were seen in a sample from Danmarks Havn, Aug. 15th 1907, and they agreed well with the species here quoted.

Distrib. West of Norway; fjords of northern Norway; north and west of Spitsbergen; East Greenland Sea at 71°—72° N. Lat.; Atlantic 45° N. Lat. 49° W. Long.

III. Foraminifera.

In a single sample from the inner part of the pack-ice, July 1908, I found a few specimens of *Globigerina*, most probably *G. bulloides* d'Orb., a well known, widely distributed oceanic plankton organism.

IV. Incertae sedis.

In his famous work on plankton Hensen (1887) has mentioned and figured an obscure organism which he named "Sternhaar-statoblast", as occurring in the Baltic; this organism was found in a sample from September 10th 1907 from Danmarks Havn, but very rare.

3—10—1910.

XI.

MARINE PLANKTON

FROM

THE EAST-GREENLAND SEA

(W. OF 6° W. LONG. AND N. OF 73° 30′ N. LAT.)

COLLECTED DURING THE "DANMARK EXPEDITION" (1906—1908)

III. PERIDINIALES

BY

OVE PAULSEN

1910

The plankton samples collected during the Danmark-Expedition by Mr. A. Lundager may be grouped in the following categories:

1. Samples collected in the open ocean east of the Greenland ice on the way out in 1906 and homeward in 1908. Like Dr. Ostenfeld, who has worked out the Diatoms and Flagellates, I think these samples are of no special interest. All of them have been taken in July—August, and on the way home they were collected with so small intervals that it has been quite sufficient to examine only a selected number of them.

2. Samples collected in the drifting ice (pack-ice) off East Greenland in August 1906 as the "Danmark" went in to the Greenland coast, and in July 1908 when it was homeward bound. On the way out a great many samples were collected, until 12 in a day and a night, and as the speed was moderate and the course very curved they are very close together and many of them quite like each other. Therefore, only a certain number of them has been thoroughly investigated.

3. Samples collected in August 1906 and July 1908 near the coast of East-Greenland, from off Koldewey Island (ca. 76° 30′ N. Lat.) to ca. 78° N. Lat., thus in the coastal water.

4. Samples collected in Danmarks Havn (Denmark harbour), at 76° 46′ N. Lat., 18° 43′ W. Long., where the expedition stayed about two years, from August 1906 till July 1908. Unfortunately these samples were not taken with regular intervals but rather occasionally: there is about a dozen of samples from the summer 1907, and in 1908 samples were collected on July 21st when "Danmark" left the harbour.

In the following pages a list is given of all the Peridiniales found in these samples, and some of the species are accompanied by figures and remarks. A general description of the plankton will be giwen in a concluding paper by Dr. Ostenfeld and the present author.

The following papers deal with the Peridiniales of the East-Greenland sea:

CLEVE, P. T.: Report on the Plankton collected by the Swedish expedition to Spitzbergen in 1898. (K. Svenska Vet. Akad. Handl. 32, 1899).

PAULSEN, OVE: Plankton investigations in the waters round Iceland in 1903 (Meddel. fra Kommis. for Havundersøg. Ser. Plankton. Bd. I. No. 1. 1904). (Cited as: Plankton invest Iceland 1903).

BROCH, HJ.: Plankton tables. In Damas et Koefoed: Le plankton de la mer du Grönland. (Duc d'Orléans: Croisière océanographique accomplie à bord de la Belgica dans la mer du Grönland 1905). Bruxelles 1909.

PAULSEN, OVE: Plankton investigations in the waters round Iceland and in the North Atlantic in 1904. (Meddel. fra Kommis. for Havundersøg. Ser. Pankton. Bd. I. No. 8), 1909.

BROCH, HJALMAR: Das Plankton (Zoologische Ergebnisse der Schwedischen Expedition nach Spitzbergen 1908. Teil I, 2). (K. Svenska Vet. Akad. Handl. 45, No. 9. 1910)[1]. (Cited as: Broch, Spitzbergen Plankton).

Yet, for easy reference, by each species the following paper is cited:

PAULSEN, OVE: Peridiniales (Nordisches Plankton, herausgeg. v. Brandt u. Apstein XVIII). Kiel 1908.

Dinophysis Ehrenberg.

1. **Dinophysis norvegica** Claparède & Lachmann, Mém. inst. nat. Genév. 1859, p. 407, tab. XX, fig. 19. Paulsen Nord. Plankton, p. 14, fig. 11—12. Broch Spitzbergen plankton 1910, p. 31, fig. 1, I. *D. acuta* auct. plur., non Clap. Lachm.

Single specimens, agreeing with var. *crassior*, PAULSEN l. c. and also with BROCHS drawing, were found in the outer part of the pack-ice and in the open sea.

Distrib. Seems to be a neritie and boreal but hardly arctic species.

2. **Dinophysis arctica** Mereschkowsky, Archiv f. mikroskop. Anatomie 1879, p. 177, tab. XI, fig. 19. Paulsen Nord. Plankton p. 15, fig. 14 (a bad figure), Broch Spitzbergen plankton p. 31, fig. 1, II. *D. granulata* Cleve & auct. plur.

BROCH (l. c.) says that this species bears fine and distant poroids on the surface while *D. norvegica* is coarsely areolated. My annexed fig. 1 shows that this is not always the case, this specimen (and many others) being very coarsely areolated. Besides, I have often found cells of this species provided with small protuberances at the

[1] In this paper which appeared as I had finished the examination of the plankton samples, BÜTSCHLI's theory on the intercalary striae as growth-marks is shown to hold good, the growth of the different species is studied in detail, and the arrangement of their plates is expressed in formulae. It will really be an advantage if the plate-arrangement proves to be so constant as supposed by BROCH. — A lack in BROCH's paper is that he gives no measures of the organisms, he confines himself to criticise those given by me. His paper will be often mentioned in the following.

lower end (see the drawing), like those of *D. acuminata*. Nevertheless I think it would be premature to unite these two species *D. arctica* having a much shorter and broader form. Jörgensen (Bergens Museums Aarbog 1900, No. III, p. 19) names the species *D. acuminata var. granulata*. Length 36—42 μ. — *D. arctica* was found in several samples from the pack-ice and the open sea outside it, mostly few specimens, and as single ones in the coast water and in Danmarks Havn.

Fig. 1. *Dinophysis arctica*. 375 t. m.

Distrib. Arctic species.

3. **Dinophysis rotundata** Claparède & Lachmann Mém. inst. nat. Génévois 1859, p. 409, tab. XX, fig. 16; Paulsen Nord. Plankton p. 17, fig. 18.

Fig. 2 represents a cell with a very coarsely areolated wall and broad intercalary band. The epitheca is relatively large, and oblique. This cell, whose length was 60 μ, is supposed to be an old one. Other cells with finer areolated surfaces were 40—52 μ long. From this it may be seen that the arctic specimens are somewhat bigger than those from southern waters, whose length was given by Bergh and in Nordisches Plankton by me as 48 μ.

Fig. 2. *Dinophysis rotundata*. 375 t. m.

Dinophysis rotundata was found very sparingly both in the coastal water, the pack-ice and outside it.

Distrib. Boreal oceanic species, widely distributed in the northern Atlantic and its tributaries.

Gonyaulax Diesing.

4. **Gonyaulax triacantha** Jørgensen, Bergens Museums Aarbog 1899, No. VI, p. 35. Paulsen Nord. Plankton p. 28.

A single specimen was found in a sample from the pack-ice (1906) but a great many in a sample from Danmarks Havn in September 1907 (Water 0°).

Distrib. Arctic neritic species, known from Alaska, Iceland, West coast of Norway. In the North Sea very rare.

5. **Gonyaulax** sp.

In some samples from the pack-ice (1906) the little organism represented in fig. 3 was found. Length 20—24 μ. I have not succeeded in finding out its plates. In some cases the surface was covered by a great-meshed reticulation of a similar kind as that figured by Klebs in Botanische Zeitung 1884 fig. 2—5 for *Glenodinium trochoideum* (now. *Peridinium trochoideum* (Stein) Lemmermann).

Fig. 3. *Gonyaulax* sp. 375 t. m.

Goniodoma Stein.

6. **Goniodoma Ostenfeldii** Paulsen, Plankton invest. Iceland 1903, p. 20, fig. 2; Nord. Plankton p. 34, fig. 43; Broch Spitzbergen Plankton p. 32, fig. 3.

Found in single specimens in Danmarks Havn, the coastal water, and the open sea.

Distrib. Arctic, neritic species, known from North-Iceland and Spitzbergen.

Peridinium Ehrenberg.

Of late years different methods of shortly designating the plates composing the skeleton of *Peridinium* have been proposed. The first was that of FAURÉ-FREMIET, whose paper "Étude descriptive des péridiniens et des infusoires ciliés du plankton de la baie de la Hougue" was published in 1908 in Annales des sc. naturelles, zoologie. FAURÉ-FREMIET designates the plates by letters with annexed numbers, so e. g. the precingulars are named d_1—d_7, d_1 being to the right, d_2 to the left, d_3 to the right and so on. This method seems to me not to be practical.

Next to FAURÉ-FREMIET comes KOFOID, the well-known investigator of the Dinoflagellates. His paper "On Peridinium Steini Jørgensen, with a note on the nomenclature of the skeleton of the Peridinidae" was published in 1909 in Archiv für Protistenkunde 16. KOFOID employs only numerals, the different series of plates being distinguished by different numbers of apostrophes or other signs annexed to the numerals. So, the apicals are 1′—4′, intercalaries 1°—3°, precingulars 1″—7″, postcingulars 1‴—5‴, antapicals 1⁗—2⁗. Each series begins on the left side of the body and goes round it to the right side. This system is a clear one, but not very practical because of the apostrophes as to whose numbers mistakes are likely to arise[1].

BROCH in his paper on Spitzbergen plankton (1910) gives a new method of designating the plates. He uses both numerals and letters. In the same year the method was modified in "Die Peridinium-Arten des Nordhafens (Val di Bora) bei Rovigno im Jahre 1909" (Arch. f. Protistenk. 20). Here, the apicals are named 1—4 and the precingulars a—g, 1 being the rhomb-plate and a the precingular neighbouring it to the left, and both series go round the body to

[1] From the table where KOFOID has arranged previous nomenclatures it appears that he has not realized the difference between „tafeln" and „platten" as these termini were used by SCHÜTT and after him also by the present author who in Nord. Plankton did use SCHÜTTS nomenclature. It might have been mentioned that SCHÜTT's „tafeln" represent transverse series of „plates". Only the intercalaries were not recognised as a series by SCHÜTT.

the left (descending screw). The intercalaries neighbouring c, d and e are named γ, δ and ε, which is more appropriate than in KOFOID's system where 3″, 4″ and 5″ are neighbours to respectivety 1°, 2° and 3°. The antapicals are named by BROCH A and B and the postcingulars I—V. It seems to me that if we here change letters to Roman numbers and vice versa we get a more practical mode of designation. Then, the apicals will be 1—4 and the antapicals I—II, the precingulars a—g and the postcingulars A—E. Thus, we have letters along both margins of the girdle and numerals at the top and at the bottom. Fig. 4 illustrates this method of denominating.

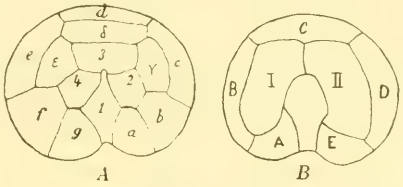


Fig. 4. Diagram of plates of *Peridinium*.

7. **Peridinium Cerasus** Paulsen, Meddel. Kommis. for Havundersøgelser, Ser. Plankton, Bd. I, No. 5. 1907, p. 12, fig. 12; Paulsen, Nord. Plankton p. 43, fig. 52. vix *P. quarnerense* (Br. Schröder) Broch, Arch. f. Protistenk. 22. 1910, p. 183.

Fig. 5 represents a specimen (36 μ long) of *P. Cerasus* which species was found rather rarely in a single sample from Danmarks Havn (Sept. 5th 1907). I think BROCH is not right in uniting this species with *P. quarnerense*, he does it because of the resemblance in the arrangement of the plates of the two species, taking a reservation on account of the incompleteness of my figures of *P. Cerasus*. In any case, my figures are clearly showing that *P. Cerasus* has a long and well marked apical horn, while *P. quarnerense* has a short one, and just this horn is the characteristic of *P. Cerasus*. The dimensions of *P. quarnerense* are unknown, so in this respect it cannot be compared with *P. Cerasus*.

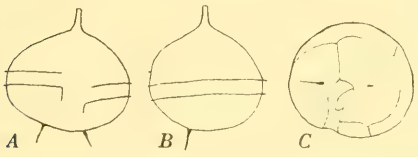


Fig. 5. *Peridinium Cerasus*. 375 t. m.

Distrib. Known from the North Sea and Iceland.

8. **Peridinium roseum** Paulsen, Plankton invest. Iceland 1903, p. 23, fig. 9; Nord. Plankton p. 44, fig. 53.—? *P. ovatum* Fauré-Fremiet, Ann. sc. nat. zool. 9. sér. 1908, p. 218, fig. 5, tab. XV, fig. 6, non Pouchet.

Found in several samples from the pack-ice and Danmarks Havn, mostly in rather few specimens.

Distrib. Boreal-neritic and arctic species, known from Norway and Iceland.

9. **Peridinium ovatum** (Pouchet) Schütt, Die Perid. d. Plankton Exp. 1895 tab. XVI, fig. 49, 1896 fig. 19. Paulsen Nord. Plankton p. 44, fig. 54. Broch, Spitzbergen Plankton p. 40, fig. 9—10, non Fauré-Fremiet 1908 p. 219, tab. XV, fig. 6. — *Protoperidinium ovatum* Pouchet Journ. Anat. Physiol. 1883 p. 35, tab. 18—19, fig. 13. *Peridinium lenticulatum* Fauré-Fremiet, Ann. sc. nat. zool. 9. sér. 1908, p. 217, fig. 4, tab. XV, fig. 5.

Occurred in single specimens in Danmarks Havn and in the coastal water. Rather common in the outer part of the pack-ice but common in the open sea outside it.

Distrib. Boreal oceanic species, widely distributed in the Atlantic and its tributaries.

10. **Peridinium curvipes** Ostenfeld, in Botany of the Faeroës 1906 p. 15, fig. 128. Paulsen Nord. Plankton p. 45, fig. 55.—? Broch, Spitzbergen Plankton p. 42, fig. 11—13.

The cells represented in the annexed fig. 6 are such as have been considered by me as *P. curvipes* although its form is broader

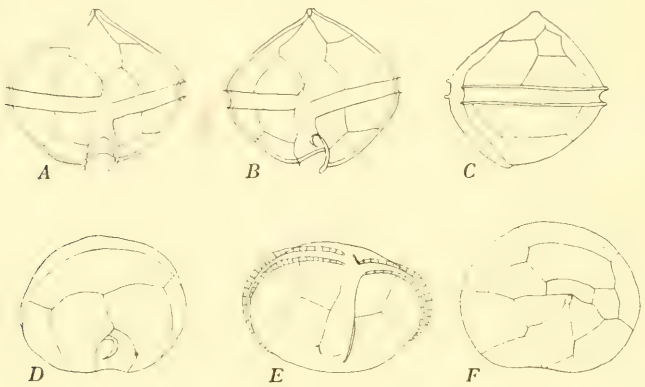


Fig. 6. *Peridinium curvipes.* 250 t. m.

and shorter than the original figure published by OSTENFELD. But those figured by BROCH l. c. are different. Unfortunately BROCH gives no figure of his species in ventral view (nor measures), but from his figures of epitheca and hypotheca it appears that the plates of his "*P. curvipes*" are arranged otherwise than in mine. Thus BROCH has the rhombplate (1) oblique, ∂ small, and the plates 1, b, 2 and a touch each other in a point, 1 and f do not touch each other. My fig. 6 shows that the rhomb-plate is not oblique and that 1 and b, 1 and f meet along vertical lines. The intercalary ∂ is long as in *P. pellucidum* and *P. islandicum*. From this difference it follows that BROCH and the present author have had different species before us. Which is the true *P. curvipes*? From

Ostenfeld's original figure (l. c.) we learn that the rhomb-plate is not oblique and that it apparently does touch nor b nor f. As to *δ*, Ostenfeld's figure gives no evidence. An attempt to find the original specimens was without result. But as the form of the rhomb-plate is the most conspicuous difference between Broch's and my specimens I venture to maintain that Broch has not had *P. curvipes* before him. He says his species is in habit very like *P. ovatum*, and this statement as well as his fig. 13 representing "*P. curvipes*(?) ... Ein Individuum ... mit ausserordentlich stark entwickelten Intercalarstreifen" call to mind *P. decipiens* Jørgensen, which, however, has no spines.

P. curvipes was found in many samples from the pack-ice, the coastal water, and Danmarks Havn, as a rule in few specimens only, but in larger quantities in samples collected in the pack-ice in August 1906.

Distrib. Arctic(?) neritic species, known from W.-Greenland, Iceland, the Faeroës, and the North Sea.

11. **Peridinium breve** Paulsen, Meddel. fra Kommis. for Havundersøg. Ser. Plankton, Bd. 1, No. 5. 1907, p. 13; Nord. Plankton p. 46, fig. 56; Broch, Spitzbergen Plankton p. 47, fig. 21. *P. Steinii* Jørgensen *f. brevis*, Paulsen, Meddel. Kom. Havund., Ser. Plankton Bd. 1, No. 3, 1905, p. 4, fig. 3 a—c, f.

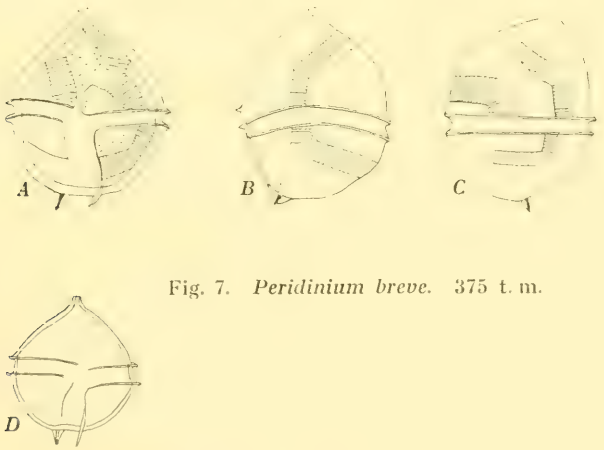


Fig. 7. *Peridinium breve*. 375 t. m.

Fig. 7 shows four cells of this species, which is indeed difficult to discern from its relatives *P. Steinii* Jørg., and *P. pyriforme* Pauls.

A—C has grown very old, thick and thick-walled, and the intercalary bands are very broad. Length 56 *μ*, surface finely reticulated. D is a small form, 40 *μ* long.

This species was found sparingly in few samples from the pack-ice and the coastal water.

Distrib. Arctic species, known from Spitzbergen and Iceland.

12. **Peridinium pyriforme** Paulsen, Meddel. fra Kommis. for Havundersøg. Ser. Plankton, Bd. 1, No. 5, 1907, p. 13, fig. 15; Nord. Plankton p. 46, fig. 57. *P. Steinii* Jørgensen *f. pyriformis* Paulsen, Meddel. Kom. Havund. Ser. Plankton Bd. 1, No. 3. 1905, p. 4, fig. 3 d—e.

Fig. 8 shows a species which was fairly common in some of the samples taken in August 1908 in the open water outside the pack-ice, and which I cannot refer to any other species than *P. pyriforme*. Length 42—52 μ. It differs from *P. breve* by the taller form, the irregular position of the intercalary *δ*, which in *P. breve* is regular (Broch l. c.) and in the very narrow rhomb-plate, but, as stated above, these two species are closely allied to each other.

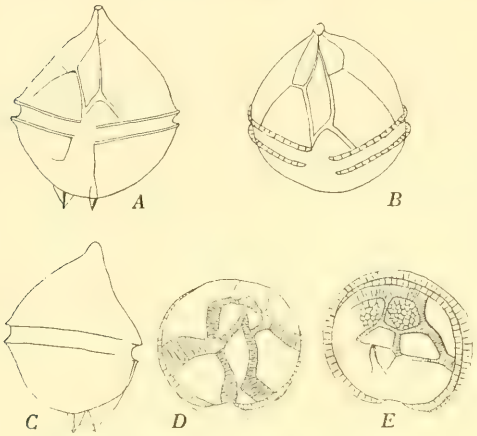


Fig. 8. *Peridinium pyriforme*. 375 t. m.

On the other hand, our species is nearly related to *P. Steinii* Jørgensen. As to the arrangement of the plates (see fig. 8 D, E) they are nearly identical, so the precingular a is small, the rhomb-plate narrow, and the intercalary *δ* has an oblique position (KOFOID in Arch. f. Protistenk. 1909, Taf. 2; BROCH, Spitzbergen Plankton p. 49, BROCH in Arch. f. Protistenk. 1910, fig. 4). Our species differs from *P. Steinii* in its much thicker and shorter form and in the thecal wall being reticulate and not porulate as in *P. Steinii*. BROCH says (Spitzb. Pl., p. 49): "ein näheres Studium von *Peridinium pyriforme* wird möglicherweise zeigen, dass die Individuen dieser Art nur kräftig entwickelte Exemplare von *Peridinium Steini* sind." On the other hand, KOFOID (l. c. p. 39) declares *P. pyriforme* not to be identical with *P. Steinii*.

Anyhow, it seems to me to be the best to keep the two species distinct at any rate provisionally until further evidences may come to hand.

Distrib. Boreal oceanic species, known from the northern Atlantic and its tributaries.

13. **Peridinium pallidum** Ostenfeld, in Knudsen & Ostenfeld: Iagttag. over Overfladevandets Temperatur, Saltholdighed og Plankton paa islandske og grønlandske Skibsrouter i 1898 (1899), p. 60. Paulsen, Nord. Plankton p. 48, fig. 60. Broch, Spitzbergen Plankton p. 45, fig. 17.

Fig. 9 shows an exceptionally low cell (length 56 μ without spines) with broad intercalary bands. The relation between 1 and

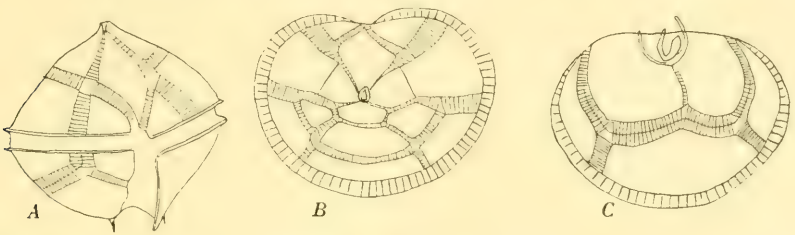


Fig. 9. *Peridinium pallidum.* 375 t. m.

f is not as shown in Broch's figure. Found in few specimens but in many samples from the pack-ice, the coastal water, and Danmarks Havn. Common in the open sea outside the ice.

Distrib. Oceanic, boreal species, widely distributed in the northern Atlantic and its tributaries.

14. **Peridinium pellucidum** (Bergh) Schütt, Die Perid. der Plankton-Exp., tab. XIV, fig. 45; Paulsen, Nord. Plankton p. 49, fig. 61; Broch, Spitzbergen Plankton, p. 44, fig. 15, 16. — *Protoperidinium pellucidum* Bergh, Morphol. Jahrb. 1881, p. 227, fig. 46—48.

All the cells seen belong to the *forma spinosa* Broch (l. c) the antapical spines being without fins. Only a single cell with fins was seen (from Danmarks Havn). In fig. 10 two specimens are drawn. A and B represent a very young cell (length 36 μ) having thin walls, and the sutures are not conspicuous without chemical treatment. D—E are showing another cell (length 40 μ) thick-walled and with broad intercalary bands. The cell represented in fig. 11 has a length of 60 μ, and the intercalary striae are very broad. Such big and thick specimens were common in some of the samples, and I refer them to *P. pellucidum* because of the girdle being not oblique as in *P. pallidum.* — Other length-

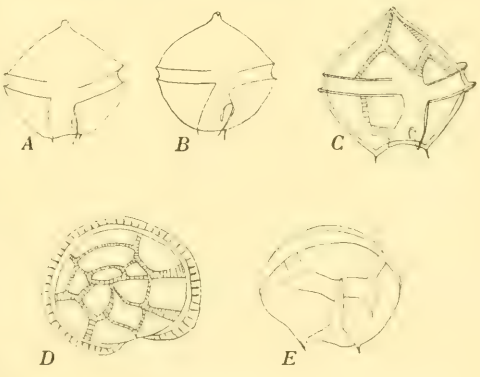


Fig. 10. *Peridinium pellucidum.* 375 t. m.

measures of this species: 38, 45, 48, 52, 56, 66 μ. *P. pellucidum* was the commonest Dinoflagellate in the samples, it occurred in Dan-

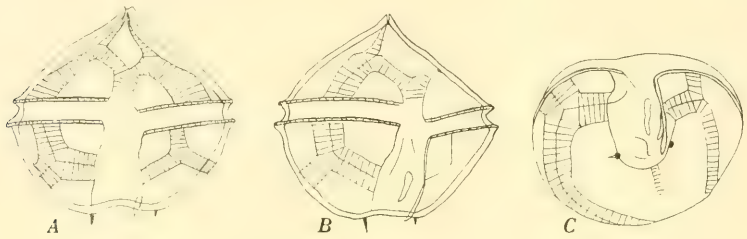


Fig. 11. *Peridinium pellucidam.* 375 t. m.

marks Havn, the coastal water, the pack-ice and in the open sea, and often frequently.

Distrib. Widely distributed neritic species, occurring from the Mediterranean to Spitzbergen and Greenland.

15. **Peridinium islandicum** Paulsen, Meddel. fra Kommis. f. Havundersøg., Ser. Plankton, Bd. I, No. 1, 1904, p. 23, fig. 7; Paulsen Nord. Plankton, p. 49—50, fig. 62; Broch, Spitzbergen Plankton, p. 46, fig. 18—20.

The cells were rather flat, es they have been figured by Broch. A single specimen measured was 44 μ long. Icelandic specimens are 53—62 μ (Nord. Plankton.) The species was fairly common in Danmarks Havn, the coastal water, and the pack-ice, but in the open sea it was found once only.

Distrib. Arctic neritic species, known from North Iceland, Spitzbergen and Greenland.

16. **Peridinium varicans** n. sp. (fig. 12).

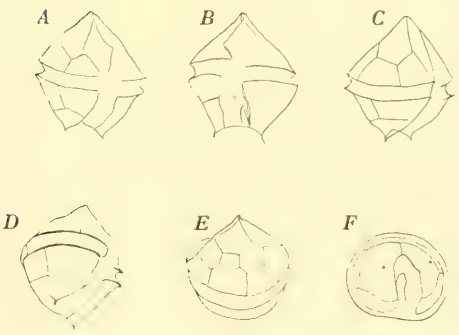


Fig. 12. *Peridinium varicans.* 375 t. m.

Cellula globoso-rhomboidea, epitheca acuta, hypotheca spinas duas divergentes (varicantes) a fissura longitudinali remotas gerente et inter spinas linea paulum et regulariter curvata terminante, cingulo transverso dextrorsum circumiente, fossa longitudinali lata ad marginem sinistram ala augusta praedita. Epitheca tabulis 14, intercalari δ parvo, hypotheca tabulis 7 constructa. Long. cell. 36 μ. Hab. rarissime in mare gelido prope oram orientalem Groenlandiae.

This species which was found in two samples from the coastal

water and the interior part of the pack-ice (July 31th and Aug. 15th 1906) is characterized by the following features: The cell is in ventral wiew rhombic, the epitheca is pointed (*acutus*) but not tapering (*acuminatus*), the hypotheca ends in two diverging fin-less spines which are distant from the longitudinal furrow. The girdle forms a descending screw to the right. Of the plates of the epitheca, δ is small and almost quadratic whereas γ and ε are bigger and many-sided.

17. **Peridinium brevipes** Paulsen, Nord. Plankton, p. 108, fig. 151 (without description); Broch, Spitzbergen Plankton p. 48, fig. 22.

In 1908 I published the name and an outline-figure of this species which I had seen at Iceland. Broch in his paper on Spitzbergen Plankton gives detailed figures of the species, and these agree well with the annexed fig. 13. Length 36 μ (different cells measured). The form of the body and the arrangement of the plates are seen in the drawings. As to the plates, δ is small and quadratic, the rhomb-plate being broad and oblique does not touch f but touches b along a vertical line. The two small spines at the lower end of the cell may be wanting. I have seen only specimens with broad intercalary bands, but Broch has them broader yet. After his theory we have then old cells before us, but if this is the case it seems to me that they cannot be "Jugendstadium" of *P. breve*, what Broch presumes. The adult cells are much smaller than *P. breve*, and also in form they seem to differ from *P. breve*.

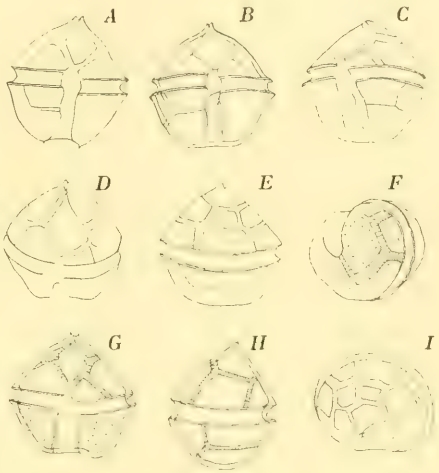


Fig. 13. *Peridinium brevipes.* 375 t. m.

P. brevipes was not common in the samples, but it is very likely that this small organism passes through the net-meshes. It was found in several samples from Danmarks Havn but in few from the coastal water, the pack-ice and the open sea.

Distrib. Arctic neritic species, known from Iceland and Spitzbergen.

18. **Peridinium depressum** Bailey, in Smithsonian contrib. to knowledge VII, 1855, p. 12, fig. 33—34; Paulsen, Nord. Plankton p. 53, fig. 67; Broch, Spitzbergen Plankton p. 51, fig. 26.

In all the specimens seen by me the antapical horns were long and hollow, so that, strange to tell, the arctic species *P. parallelum* Broch was not found in the present material.

P. depressum was found in single specimens only in the neighbourhood of the coast, repeatedly but rarely in the pack-ice and in the open sea.

Distrib. Boreal oceanic species, widely distributed.

19. **Peridinium oceanicum** Vanhöffen, in Grönl.-Exp. d. Gesellsch. für Erdk. zu Berlin II, 1897, tab. V, fig. 2; Paulsen, Nord. Plankton, p. 54, fig. 69.

var. typicum Broch, Nyt Magaz. f. Naturvid. Christiania, 44, 1906. fig. 3.

Found as a single cell in the open sea outside the ice.

Distrib. Oceanic boreal species.

20. **Peridinium conicoides** Paulsen, Meddel. fra Kommis. f. Havundersøg. Ser. Plankton, Bd. I, Nr. 3, 1905, p. 3, fig. 2; Nord. Plankton, p. 58, fig. 75; Broch, Spitzbergen Plankton, p. 53.

Not rare in several samples from the coastal water and the pack-ice in 1908.

Distrib. Arctic neritic species, known from Iceland, Spitzbergen and Greenland.

21. **Peridinium** sp.

A small species (length 20 μ) represented in fig. 14 was found in three samples from Danmarks Havn in 1907. I suppose it is a young stage of the preceeding species. In favour of this conception speeks: the whole form of the body, with convex outlines, the small hollow protuberances distant from each other, the orbicular girdle and the characteristic curvature of the longitudinal furrow's left margin. On the other hand, the number and arrangement of the plates do not permit to unite the two species at once. There is only one intercalary plate, as illustrated in fig. E, at least I have not been able to find any sutures to separate between γ, δ and ε.

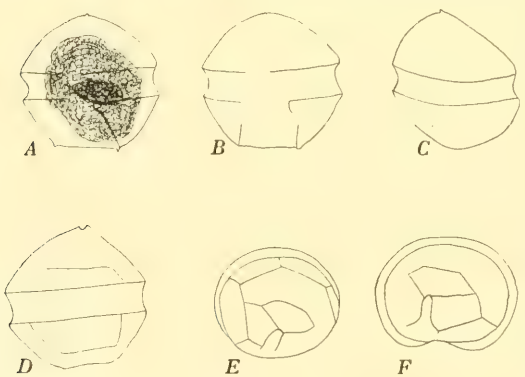


Fig. 14. *Peridinium* sp. 750 t. m.

22. **Peridinium subinerme** Paulsen, Plankton invest. Iceland

1903, p. 24, fig. 10; Nord. Plankton, p. 60, fig. 78; Broch, Spitzbergen Plankton, p. 54, fig. 28.

One of the commonest species in the samples from the pack-ice in 1906. More rarely it occurred in Danmarks Havn, the coastal water (in 1909) and in the open sea.

Distrib. Oceanic (?) arctic or boreal species, known from Iceland Greenland, Spitzbergen and (in spring) from the North Sea.

23. **Peridinium catenatum** Levander, Acta soc. pro fauna et flora fennica, IX, 1894; Paulsen, Nord. Plankton, p. 63, fig. 84.

This species, represented in fig. 15, was found rarely but in several samples from Danmarks Havn, the coastal water, and the pack-ice.

Distrib. Neritic species, known from the inner part of the Baltic, Limfjorden (Denmark), and West-Greenland.

Fig. 15. *Peridinium catenatum.* 375 t. m.

24. **Peridinium minusculum** Pavillard, Flore pélagique de l'étang de Thau, Montpellier 1905, p. 57, tab. III, fig. 7—9 (I have seen Pavillards specimens); Lemmermann, Arch. f. Hydrobiol. u. Planktonkunde, V, 1910, p. 336; *Glenodinium bipes* Paulsen, Plankton invest. Iceland 1903 (1904), p. 21, fig. 3—4; Nord. Plankton, p. 25, fig. 31.

Lemmermann (l. c.) in pointing out that *Glenodinium trochoideum* is a *Peridinium* says in a footnote that also *G. bipes* is a *Peridinium* and that it is to be named *P. minusculum (P. bipes* it cannot be named because another species, of Stein, bears that name.) It is very likely that the species is a *Peridinium.* I have seen that it has two antapicals.

P. minusculum was found, always in single specimens, in several samples from Danmarks Havn, the coast water, and the pack-ice. Without doubt most of the cells pass through the net-meshes.

Distrib. Neritic species, known from the Mediterranean, the North Sea, the Baltic, Iceland, and Greenland.

Ceratium Schrank.

25. **Ceratium arcticum** (Ehrenberg) Cleve, The seasonal distrib. of atl. Plankton-org., Gøteborg 1900, p. 207. Paulsen, Nord. Plankton, p. 86, fig. 118; E. Jørgensen, Die Ceratien, Leipzig 1911, p. 85, fig. 181. *Peridinium arcticum* Ehrenberg, Bericht üb. Verhandl. d. Berliner Akad. d. Wiss. 1853, p. 528.

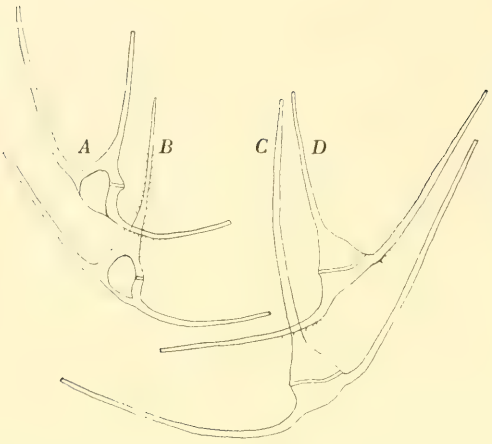


Fig. 16. *Ceratium arcticum*, different cells. 94 t. m.

This species of which fig. 16 gives some outline-figures, was very common in Aug. 1908 in the sea outside the ice. In the pack-ice and the coastal water in 1908 it was scarce though found in several samples. In Danmarks Havn and in the pack-ice and the coastal water in 1906—07 it was rare and occurred always as dead specimens.

Distrib. Arctic oceanic species.

Apodinium Chatton.

26. Apodinium (?) Chaetoceratis n. sp.

Cellulae globosae nucleiferae membrana cellulosoidea tectae, ad setas Chaetoceratis borealis appendicula adharentes et membranam ejus perforantes: parasitus igitur plasma hospitis exhauriens. Divisionibus cellulae binae et quaternae nascuntur. Long. cell. ca. 13—25 μ. Hab. in mare gelido ad oram orientalem Groenlandiae.

Dr. OSTENFELD who has worked out the Diatoms and Flagellates of the present samples before I got them for investigation, called my attention to this organism which he had examined believing it was a Diatom. But as the wall gave cellulose-reaction with chloriodide of zinc and as it was without silicium he saw it would be nearer a Dinoflagellate than a Diatom, and he gave me his drawings and notes.

Once only I have found a cell of *Apodinium Chaetoceratis* upon an awn of *Chaetoceras decipiens*, all other specimens seen were fixed on the awns of *Ch. boreale*. Whether this is because the awns of *Ch. boreale* are set with fine hairs I cannot tell with certainty, I have never seen the cells spit upon the hairs or otherwise fixed to them. But it seems likely that awns set with setae afford better chance for fastening than smooth ones. How the cell is fixed to the awn is difficult to discern. Fig. 17, C and D show a little process by aid of which the cell is fixed. In other cases it seems that there are two processes. Fig. F shows a cell made pellucid by aid of Eau de Javelle, and on both sides of the awn is seen a thickening not belonging to the awn but to the *Apodinium*. Fig. I (drawed by OSTENFELD) shows two cells in a mucilage which is

fixed to the awn, such a thing I have not seen, and perhaps it does not belong to *Apodinium*.

The wall of the awn is perforated. In fig. G the perforation is distinctly seen. Through this hole the contents of the *Chaetoceras*-

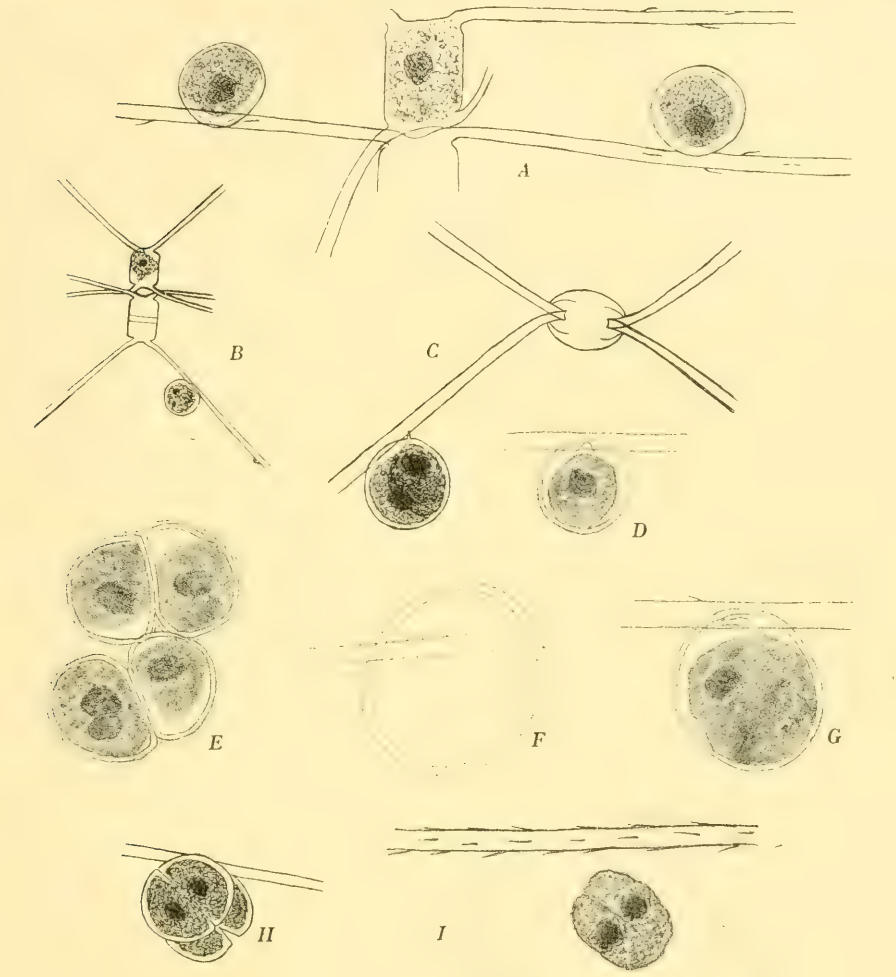


Fig. 17. *Apodinium*(?) *Chaetoceratis*. (See the text) A, C, D 375 t. m. B 125 t. m. E, F, G 750 t. m. H, I 500 t. m. (Fig. B, C, H, I were drawn by Dr. Ostenfeld.)

cell must be sucked out, — and all the *Chaetoceras*-cells seen bearing an *Apodinium* were empty, see fig. A, B, C.

The contents of the *Apodinium*-cell consists of a granular plasma and a rather big nucleus which often is seen to have been divided (fig. C, E). The divisions must follow speedily after each other, as

two or four cells are often seen to be together and again dividing. The cell-wall is rather thick, in some cases I have been able to see a three-fold outline (fig. E); the outmost layer is very thin and inconspicuous, by treatment with chloriodide of zinc it disappears but not with Eau de Janelle (a mucilage?) The wall itself is coloured brownish violet by chloriodide of zinc. In spite of eager research it has not been possible to find other stages of this organism than those here mentioned and figured.

The systematic position of this species, imperfectly known as it is, must of course be uncertain. I refer it with some doubt to the genus *Apodinium* Chatton (Comptes rendus Ac. sc. Paris 144. 1907, p. 283, with figures. Se also: ibid. 143, Chatton: Les Blastodinides, ordre nouveau des Dinoflagellés parasites.) The other Blastodinidae described and figured by CHATTON are far from being like our species, but *Apodinium mycetoides*, a parasite upon *Appendicularia*, shows some features which call to mind *A. Chaetoceratis*. *A. mycetoides* is fixed upon the host by a long stalk. Growing up and dividing it has at first some resemblance to our species, being two-celled and of about the same form, but it is only partly filled by plasma, a great "lacune aqueuse" taking most of the room in the two cells. Later on the distal cell ("blastocyte") divides again forming many spores which again divide, and so a lot of small *Gymnodinium*-like spores are formed. The proximal blastocyte after a rest divides, and the new distal cell forms a new generation of spores, as described above.

Of all this I have found no trace by *Apodinium(?) Chaetoceratis*. As a whole this species may be called rather dubious.

14—3—1911.

XI.

MARINE PLANKTON

FROM

THE EAST-GREENLAND SEA

(W. OF 6° W. LONG. AND N. OF 73° 30′ N. LAT.)

COLLECTED DURING THE "DANMARK EXPEDITION" 1906—1908

IV. GENERAL REMARKS ON THE MICROPLANKTON

BY

C. H. OSTENFELD AND OVE PAULSEN

1911

Introduction.

As remarked in the introduction to the foregoing lists of the organisms of the microplankton (see list of literature p. 336), only the plankton from the region west of 6° W. L. and north of 73° 30′ N. L. has been worked up by us. The series of samples from this region, the principal contents of which are shown in the accompanying Tables (I—III), can be most conveniently considered under three divisions, namely:

I. Samples from Danmarks Havn (76°46′ N. L., 18° 43′ W. L.).
II a. Samples collected during the passage of the ship through the ice on the outward journey.
II b. Samples collected during the passage of the ship through the ice on the return journey.

In the following the samples from Danmarks Havn will be dealt with separately and the remaining samples together. With regard to the grouping of the latter into two divisions, reference may be made to our previous papers. Here all the species found are also named as well as details about the places where they were found.

The first information regarding the plankton of these waters came from the Danish Expedition to Scoresby Sound (1891–92). In a large paper on the marine diatoms published in 1895, E. Østrup also dealt with a number of plankton samples from the ice-filled sea, but did not deal with the plankton associations as such. The Swedish Expedition to East Greenland in 1899 collected a quantity of plankton which was investigated by P. T. Cleve (1900). His report contains tables and short remarks on the commoner species. Of special interest to us here are the samples collected in the drift-ice in July between 70° 30′ N. L. and 74° 29′ N. L., and the samples from the fjords of North-East Greenland, 71°—73° N. L., collected in August.

The drift-ice samples are specially characterized by such organisms as *Chaetoceras decipiens, C. furcellatum* and *C. sociale, Coscinodiscus oculus iridis* (= *subbuliens), Fragilaria oceanica, Thalassiosira gravida* — all of which are regarded by Cleve as arctic forms — and thus show a good agreement with the samples dealt with here.

The fjord samples are all very poor; the most prominent species are *Chaetoceras decipiens, Dinobryon pellucidum* (only in some samples), *Calanus finmarchicus*, whilst *Ceratium arcticum, Cyttarocylis gigantea* and *Oithona similis* occurred in quantity in a few samples.

Lastly, from the Duke of Orleans' Expedition of 1905 we have an interesting work by D. Damas and E. Koefoed, which in the introduction speaks of the rich phytoplankton found in July—August in the drift-ice and in the coastal waters of East Greenland, in contrast to the small quantities found in the open Greenland Sea, but otherwise does not deal with the microplankton. The phytoplankton was determined by H. Broch, who has arranged it in tabular form without text.

According to Broch's tables the most prominent species in the phytoplankton are *Ampiprora hyperborea, Bacterosira fragilis, Chaetoceras atlanticum, C. boreale, C. criophilum, C. decipiens, C. furcellatum, C. Wighami, Fragilaria oceanica, Navicula Vanhöffenii, Nitzschia delicatissima, Thalassiosira gravida, T. hyalina, T. Nordenskiöldii, Phaeocystis Pouchetii.* Specially prominent are *Fragilaria oceanica* and *Thalassiosira gravida. Chaetoceras criophilum* was predominant in a single sample from the open sea, whilst *Ceratium arcticum*, just as in the other samples, was rare. These samples show good agreement on the whole with ours, except that *Thalassiosira gravida* and *Chaet. criophilum* play a much smaller role in our samples.[1]

I. Plankton from Danmarks Havn. (Table 1).

It has several times been emphasized in our previous papers, that the collecting of plankton in Danmarks Havn, where the Expedition was stationed for ca. 22 months (1906—1908), has unfortunately been very incomplete. A series of samples collected at regular intervals could have given an excellent picture of the development of the plankton throughout the year, but from the few samples collected occasionally which we have, we obtain only an imper-

[1] Unfortunately there is not always agreement between Broch's tables and the published „Journal des stations" of the Expedition. Thus for Station 44 the table has a haul of 390—300 m. with a rich diatom plankton, which seems peculiar at this great depth. In the Journal this haul is not mentioned, but a corresponding one of 300—0 m. with almost the same organisms. Other differences also occur.

fect impression of the annual cycle of plankton. The following samples were collected: 4 in October 1905, 2 in June, 4 in August and 2 in September 1907, and one sample on July 21st 1908, when the Expedition left the station.

Table I gives the principal species and their occurrence in the samples; the rarer species have been omitted (with regard to them, see the systematic lists in our previous papers).

The samples from the beginning of October 1905, which were all taken in holes in the ice from water with a temperature of ca. — 1·7° C.,[1] contain very few organisms. They are the last remnants of the summer plankton, mostly dead shells of diatoms, *Ceratium arcticum* and *Cyttarocylis denticulata*, as also a few living *Chaetoceras boreale*, *Ch. decipiens*, *Rhizosolenia styliformis* and Peridinians, with some *Oithona* and Nauplii. Lastly, it was interesting to find that *Coscinodiscus Joergensenii* was in process of forming auxospores at this time of year, though in very few individuals.

The two spring samples from June 1907 were also from holes in the ice (water temperature ca. — 1·7° C.) and contained even fewer organisms. It was only in the last of the two samples that any fair quantity of *Melosira hyperborea* was taken, its chains in process of active division, as also some *Oithona* and Nauplii.

The August samples (the first was taken on July 30th) contain a rich diatom plankton. The principal species are *Chaetoceras sociale* and *Fragilaria oceanica*, in the later also *Chaetoceras diadema*, *Ch. Wighami* and *Coscinodiscus subbuliens*, as well as *Cyttarocylis denticulata* and in smaller numbers *Nitzschia seriata*, *Thalassiosira gravida*, *Peridinium pellucidum* and *P. islandicum*, further *Ptychocylis obtusa* and *Tintinnus vitreus*.

The September samples show almost the same plankton, yet are somewhat poorer for most species; only *Peridinium pellucidum*, *P. islandicum*, *Synchaeta sp.*, *Oithona*, as also *Cyttarocylis denticulata typica* and *gigantea* are more frequent, and *Gonyaulax triacantha* is added.

Among the diatoms in September resting-spore formation is found in *Chaet. sociale*, *Ch. diadema*, *Thalassiosira gravida*, and also in *Fragilaria oceanica*, the resting-spores of which, however, already occurred in August, though less frequently. The rare *Ch. gracile* had resting spores in August. In *Coscinodiscus subbuliens* auxospores were present, but in small quantity, in August and September.

The salinity of the water was highest in June (32·3‰) and de-

[1] The hydrographical data (surface temperature and salinity) have been kindly placed at our disposal by the Captain of the "Danmark", First-Lieutenant H. Trolle, to whom we wish here to express our thanks.

Table I. Danmarks Havn. 1906—1907.

Date	2. X	4. X	5. X	5. X	3. VI	15. VI	30. VII	4. VIII	15. VIII	24. VIII	5. IX	10. IX
Time / W. Latitude / N. Longitude	Opening in the ice, harbour	Ice-edge at harbour-point	Opening in the ice, at harbour-mouth	Opening in the ice, the fjord	Opening in the ice	Chink in the ice, the fjord	Surface-haul harbour	Surface-haul harbour	11.30 a. Western harbour-point	1.30 p. Western harbour-point	Between harbour-point and Koldewey	Mouth of harbour
Temperature of water	ca. ÷ 1·7				ca. ÷ 1·7		4·5	3·6	÷ 0·4	÷ 0·8	0·0	
Salinity of water	30·8				32·3		0·6	1·8	27·1	27·1	15·4	28·0
No. of sample	88	89	90	91	26 (27)	134 (135)	402	403	404	405 (406)	408	409
Bacillariaceae												
Amphiprora hyperborea	...	...	...	...	...	rr	...	...	rr	rr	...	...
Chaetoceras atlanticum	...	...	...	...	...	...	...	...	rr	rr	...	r
— boreale	rr[1]	r[1]	r[1]	...	...	...	...	...	rr	rr	rr	rr
— convolutum	...	...	...	...	...	...	...	...	rr	rr	...	rr
— decipiens	rr[1]	+[1]	r[1]	rr	...	rr[1]	...	rr	r	...	rr	r
— diadema	...	...	...	...	...	...	...	...	+	+	+ (c. sp. rr)	+ (c. sp. rr)
furcellatum	...	...	...	...	...	...	...	...	...	...	...	...
— sociale	...	...	...	...	...	...	cc[1]	cc	cc	cc (c. sp. +)	rr (sp.)	+ (c. sp. rr)
— Wighami	...	...	...	...	...	...	...	...	+	r	...	rr
Coscinodiscus subbuliens	...	...	rr	rr	rr	...	rr[1]	rr	cc	c	c	c
Fragilaria oceanica	rr	rr	...	...	...	...	+[1] (c. sp. rr)	+ (c. sp. rr)	cc (c. sp. c)	c (sp.)	r (sp.)	rr (sp.)
Melosira hyperborea	rr[1]	rr[1]	...	rr[1]	...	+	rr[1]	...	...	rr[1]	...	...
Navicula septentrionalis	...	...	...	...	...	rr	...	...	...	...	...	...
Nitzschia seriata	...	...	...	...	...	...	...	r	+	r	...	...
Rhizosolenia hebetata f. semispina	...	...	...	...	...	...	...	...	...	...	...	...
— obtusa	...	...	...	...	...	...	...	...	...	...	...	...
— styliformis	rr	rr	rr	rr[1]	...	...	...	...	...	rr	...	rr
Thalassiosira bioculata	...	...	...	...	...	...	...	...	...	rr	...	rr
— gravida	...	...	...	...	...	...	rr[1]	rr	r	rr	rr	rr (c. sp. rr)
— Nordenskiöldii	...	...	...	...	...	...	...	...	rr	rr	...	rr
Flagellata												
Dinobryon pellucidum	...	...	...	...	...	...	...	...	rr	...	...	...
Distephanus speculum	...	...	...	...	...	...	...	...	rr	rr	...	rr

Phaeocystis Pouchetii	...	...	...	...	...	...	...	...	...	...	...	...
Coccolithophora pelagica	...	...	...	...	...	...	...	...	...	...	...	...
Pontosphaera borealis	...	...	..	...	...	...	...	...	...	...	...	...
Tintinnodea												
Cyttarocylis denticulata, typica	rr[1]	r[1]	r[1]	+[1]	...	rr[1]	...	...	+	+	+	c
— — gigantea	...	...	...	...	...	...	...	...	...	...	+	+
— — robusta	...	...	...	...	...	...	...	...	...	...	...	r
Ptychocylis obtusa	..	rr[1]	rr[1]	...	...	...	...	...	r	+	r	r
Tintinnus norvegicus, gracilis	...	...	...	...	...	...	...	...	...	...	...	...
Peridiniales												
Apodinium (?) Chaetoceratis	...	...	..	...	...	...	...	...	...	...	...	...
Ceratium arcticum	r[1]	r[1]	rr[1]	rr[1]	...	..	...	...	...	...	...	rr
Dinophysis arctica	...	...	...	rr	...	...	...	...	...	...	...	...
— rotundata	rr	..	...	...	...	...	..	...	...	...	...	...
Goniodoma Ostenfeldii	...	...	...	...	...	...	...	...	...	rr	...	...
Gonyaulax triacantha	...	...	...	...	...	..	...	...	...	...	+	rr
— sp.	...	...	rr	...	..	.	...	...	...	...	...	...
Peridinium breve	...	...	...	rr	...	..	...	...	...	...	...	...
— brevipes	...	...	rr	...	...	...	...	...	...	rr	r	rr
— catenatum	..	...	...	...	..	...	...	...	rr	...	rr	rr
— conicoides	...	...	...	...	...	...	...	...	...	...	...	...
— curvipes	...	rr	...	...	...	...	...	...	...	...	...	...
— depressum	...	rr	...	...	...	...	...	...	...	...	...	...
islandicum	...	rr	...	rr	...	...	...	rr	r	r	+	...
— minutum	r	...	...	...	...	...	...	rr	rr	rr	rr	...
— ovatum	...	...	...	...	...	...	...	...	...	...	...	rr
— pallidum	rr	...	...	...	...	...	...	...	...	...	rr	...
— pellucidum	...	...	rr	...	...	..	...	rr	r	r	+	r
— pyriforme	...	...	...	...	...	..	...	...	...	...	...	...
— roseum	...	...	...	...	...	...	...	...	...	rr	rr	r
— subinerme	...	...	...	rr	...	...	...	...	rr	...	...	...
Metazoa												
Calanus finmarchicus	...	rr	...	...	...	...	..	...	...	...	...	r
Oithona similis et Nauplii	r	r	r	r	rr	+	...	...	r	rr	cc	cc

[1] Mostly dead specimens.

Table II. 1906.

Date	31. VII	1. VIII	2. VIII	2. VIII	3. VIII	5. VIII	7. VIII	13. VIII	15. VIII	15. VIII	16. VIII
Time	9·30 p.	12·30 p.	4·30 a.	2 p.	1·30 p.	12 n.	12·30 a.	3 a.	1 a.	5·30 a	2·30 p.
N. Latitude	75·26	75·35	75·19	75·38	75·58	75·58	75·48	76·20	77·16	77·25	77·0
W. Longitude	6·10	8·15	10·35	11·05	10·15	11·31	12·52	18·20	18·30	18·25	18·09
Temperature of water	1·9	1·0	÷ 0·7	÷ 0·4	÷ 0·4	÷ 1·2	÷ 0·7	0·5	÷ 0·5	0·4	0·5
Salinity of water	32·8	31·9	31·2	31·3	31·9	31·8	31·2	—	30·6	—	—
No. of sample	12	13	14	15	16	17	18	19	21	22	23
Bacillariaceae											
Amphiprora hyperborea	...	...	...	rr	...	...	...	...	...	...	...
Chaetoceras atlanticum	...	rr	...	...	...	..	rr	...	r	...	rr
— boreale	...	...	...	...	...	...	+	c	c	c	c
— convolutum	c	+	+	c	c	rr	...	...	...	...	rr
— decipiens	rr	rr	r	+	r	...	c	c	cc	c	cc
— diadema	...	...	...	rr	...	...	...	...	...	...	...
— furcellatum	...	...	...	...	...	...	...	...	...	...	...
— sociale	...	...	...	...	...	...	...	...	...	...	...
— Wighami	...	...	...	...	...	...	...	...	...	...	...
Coscinodiscus subbuliens	...	...	...	...	...	rr[1]	...	c	+	+	r
Fragilaria oceanica	...	...	...	rr[1]	rr[1]	...	...	...	...	...	...
Melosira hyperborea	...	...	...	rr (sp.)	...	c (c. sp. +)	rr (sp.)	rr	...	...	rr
Navicula septentrionalis	...	...	...	...	...	...	...	...	...	...	...
Nitzchia seriata	...	...	...	...	...	...	...	...	...	...	...
Rhizosolenia hebetata f. semispina	c	+	+	cc	cc	rr	...	...	...	...	...
— obtusa	r	c	+	c	c	rr	...	...	...	...	...
— styliformis	...	...	...	...	...	rr	r	r	+	r	rr
Thalassiosira bioculata	...	...	...	...	...	rr	rr	...	r	...	rr
— gravida	...	...	rr	rr	...	...	...	...	...	...	...
— Nordenskiöldii	...	...	rr	...	...	...	...	...	...	...	...
Flagellata											
Dinobryon pellucidum	...	r	+	...	...	...	...	...	...	...	...
Distephanus speculum	...	rr	...	rr	rr	...	...	...	...	...	...

Phaeocystis Pouchetii	...	...	r	...	...	...	...	...	...	...	...
Coccolithophora pelagica	rr[1]	rr[1]	rr[1]	...	...	...	...	...	...	...	...
Pontosphaera borealis	rr	r	rr	rr	rr	...	...	...	...	...	...
Tintinnodea											
Cyttarocylis denticulata, typica	cc	cc	c	c	c	rr[1]	...	...	...	...	...
— — gigantea	...	...	...	...	...	...	...	...	...	...	...
— — robusta	c	cc	c	c	c	c[1]	+[1]	r[1]	...	rr[1]	...
Ptychocylis obtusa	...	...	...	...	...	...	...	...	...	...	...
Tintinnus norvegicus, gracilis	rr	...	...	r	...	+	...	...	...	...	...
Peridiniales											
Apodinium (?) Chaetoceratis	...	...	...	...	...	...	...	rr	rr	rr	rr
Ceratium arcticum	rr[1]	rr[1]	rr[1]	rr[1]	...	rr	rr[1]	rr[1]	rr	rr[1]	rr[1]
Dinophysis arctica	rr	rr	...	rr	rr	...	rr	rr[1]	...	rr	rr[1]
— rotundata	rr	...	rr	rr	rr	rr	rr	...	...	...	...
Goniodoma Ostenfeldii	...	...	...	...	...	...	...	...	...	...	...
Gonyaulax triacantha	...	...	rr[1]	...	...	...	...	...	...	...	...
— sp.	...	r	...	rr	...	rr	...	...	...	rr	rr
Peridinium breve	...	...	...	...	...	...	...	...	...	...	...
— brevipes	...	...	...	...	...	...	...	...	...	...	...
— catenatum	...	...	...	...	...	...	...	...	...	rr	rr
— conicoides	...	...	...	...	...	...	...	...	...	...	...
— curvipes	+	rr	c	+	+	r	...	...	...	...	...
— depressum	...	...	...	...	...	...	...	...	...	...	...
— islandicum	rr	...	+	r	...	...	...	rr[1]	...	...	...
— minutum	...	...	...	...	...	rr	...	...	...	rr	...
— ovatum	...	...	...	...	...	...	...	...	...	...	...
— pallidum	...	...	...	...	r	...	...	...	rr	...	...
— pellucidum	r	+	+	+	r	r	...	rr	...	...	rr
— pyriforme	...	...	...	...	...	...	...	...	...	...	...
— roseum	r	rr	...	r	+	rr	...	...	...	...	...
— subinerme	rr	+	c	c	c	r	...	...	...	...	...
Metazoa											
Calanus finmarchicus	...	...	...	...	...	c	r	.	+	c	...
Oithona similis et Nauplii	+	..	.	rr	r	+	+		+	+	...

[1] Mostly dead specimens.

creased greatly in the course of the summer owing to the inflow of fresh water from the melting snow of the land, so that on the surface it was brought down to 0·6—1·8‰ at the end of July, at the same time that the temperature rose to 3·6°—4·5° C., the effect of which was that the marine organisms were for a great part killed, and only the resting-spores of diatoms were living. The samples from this period really contained in the main freshwater organisms, which had been carried out by the freshwater from land, for example, *Coelastrum microporum*, *Gomphosphaeria lacustris*, *Anabaena sp.*, *Spirotaenia sp.*, *Staurastrum sp.*, *Hyalotheca sp.*, and many freshwater diatoms. In August—September the salinity again rose and the temperature sank (ca. 27—28‰ and ca. 0°), and at the same time the freshwater forms disappeared and marine species ruled again. The samples from October 1906 permit us to conclude, that the salinity continues to rise, most probably owing to the formation of ice, and the temperature to fall, just as they presumably show the demise of the plankton (see above).

The planton of Danmarks Havn is thus an arctic coast-plankton with a flowering period of short duration in late summer. It is somewhat poor in species and consists mainly of neritic diatoms, which have a wide distribution in northern seas, also outside the arctic region. Truly arctic are probably only the following species, none of which were very abundant in the samples: *Bacterosira fragilis*, *Eucampia groenlandica*, *Chaetoceras gracile*, *Biddulphia arctica*, *Navicula septentrionalis*, *N. Vanhöffenii*, *Peridinium islandicum*, *P. brevipes*, *P. catenatum*, *Gonyaulax triacantha*, *Tintinnopsis karajacensis*, *T. pellucida* and *Tintinnus vitreus*.

II. Plankton of the drift-ice and coastal waters.

a. August 1906. (Table II).

The samples (11) belonging here were collected during the period from July 31st to August 16th in the ice-filled waters; they fall naturally into two groups:

The outermost group (5 samples) are from water with a temperature of —0·7° to —1·9° C. and a salinity of 31·2—32·8‰ and they were taken between ca. 6°—11° W. L. (ca. 120—180 miles from the coast). The plankton is very uniform in all the samples; it consists mainly of diatoms and tintinnids; the most frequent species are *Chaetoceras convolutum*, *Rhizosolenia hebetata f. semispina*, *Rh. obtusa*, *Cyttarocylis denticulata typica* and *robusta*, *Peridinium subinerme*, *P. curvipes* and *P. pellucidum*. Characteristic, though occurring in smaller quantities, were *Coccolithophora pelagica* (dead), *Pontosphaera borealis*, *Dinophysis arctica*, *Peridinium roseum*, *Dinobryon pellucidum*

and *Distephanus speculum*. From the transition to the inner group we have a single sample (No. 17 in the Table), which mainly consists of *Melosira hyperborea* (with resting spores) and *Calanus finmarchicus*; the very low temperature (−1·2°) implies special conditions in the water, e. g. that the sample might have come from the immediate vicinity of an ice-floe.

The inner group (5 samples) come from water with a temperature of ca. 0° and a salinity of 30·6—31·2 ‰ and the samples were taken from ca. 13° W. L. (ca. 90 miles from land) in towards the coast (Germania Land and Koldewey Island). The principal species are *Chaet. boreale*, *Ch. decipiens*, which in small quantities were also found in the samples from the outer group, and *Oithona similis*; *Rhizosolenia styliformis* replaces the other two *Rhizosolenia* species. *Coscinodiscus subbuliens* and *Apodinium Chaetoceratis* only occur in the samples from near the coast. In a couple of the samples *Calanus finmarchicus* was present in large numbers. With regard to the Peridinians, *Ceratium arcticum* was found in small quantity and usually only as empty shells in all the samples (also of the outer group), whilst the other species had practically disappeared.

b. July—August 1908. (Table III).

We have examined 28 samples taken on the return voyage during the period from July 21st to August 3rd in almost the same region as the samples from 1906.

The samples can be divided naturally into three groups:

The inner group (15 samples) goes from the coast to ca. 14° W. L. The salinity determinations are few; they vary between 28·1 and 31·7 ‰ and the temperature on the surface lies between 0° and —4° C. The samples are somewhat rich in species, the most prominent being the following diatoms: *Chaetoceras decipiens*, *Ch. boreale* and *Coscinodiscus subbuliens*, and common to all is the small quantity of Peridinians: *Per. conicoides*, *P. curvipes* and *Ceratium arcticum* being the near most characteristic. Three samples taken west of Germania Land (Nos. 1276, 1279, 1289) in water with 3—4° temperature (and presumably low salinity) are wanting in, among others, *Chaet. Wighami* and *Fragilaria oceanica*, which are found otherwise in larger or smaller number in most samples. *Chaet. sociale* appears first further away from land (from No. 1290), but is then constantly present and usually in quantity. *Calanus finmarchicus* and *Thalassiosira gravida* (to a smaller extent) chiefly keep on the other hand to the samples from nearer land. The two northernmost (ca. 78° N. L.) samples (Nos. 1301, 1303) are remarkable for a large quantity of *Melosira*

Table III.

Date	21. VII	21. VII	21. VII	22. VII	22. VII	22. VII	22. VII	23. VII	23. VII	23. VII	24. VII	24. VII
Time	7 p.	8 p.	9 p.	11 a.	6. p.	10 p.	12 p.	5 a.	8 a.	11·30p.	10 a.	2 p.
W. Latitude	Mouth of the harbour	C. Bismarck—Marous-sia	Off Marous-sia	N. of Marous-sia	northwards along the coast			77.0	77·15	ca.78·0	ca.78.0	—
N. Longitude								17.15	16·0	c.15·30	c.15·30	—
Temperature of water	ca. 0·0			ca. 1·0	ca. 4·0	ca. 3·0	ca. 3.0	3.15	2·10	1·4	0·7	0·3
Salinity of water	31·7	31·7	31·7	ca. 30·0	—	—	—	28.06	29·36	—	28·7	—
No. of sample	1242	1243	1244	1270	1276	1279	1289	1290	1291	1299	1301	1303
Bacillariaceae												
Amphiprora hyperborea	r	rr	r	r	...	...	...	rr	...	...	rr	r
Chaetoceras atlanticum	...	rr	...	...	...	...	...	...	rr	...	rr	rr
— boreale	cc	c	c	cc	cc	cc	cc	c	cc	c	+	r
— convolutum	...	...	...	...	...	...	...	...	...	...	rr	rr
— decipiens	c	c	c	c	c	c	c	c	cc	c	c	c
— diadema	...	...	...	...	...	...	...	r	...	...	...	...
— furcellatum	...	...	...	...	...	...	...	...	...	...	...	...
— sociale	...	...	...	...	...	...	...	c	r	r	+ (c. sp. rr.)	cc (c. sp. r.)
— Wighami	r	r	+	r	...	...	...	cc	+	...	rr	r
Coscinodiscus subbuliens	+	c	c	c	c	cc	c	c	c	cc	rr	r
Fragilaria oceanica	cc (c. sp. +)	cc (c. sp. +)	cc (c. sp. +)	cc (c. sp. r)	...	...	...	rr	r (sp)	r (sp.)	r (sp.)	+ (c. sp. r.)
Melosira hyperborea	rr (sp.)	rr (sp.)	rr (sp.)	rr (sp)	...	rr (sp.)	rr (sp.)	...	+	+	c (c sp. +)	c (c. sp. +)
Navicula septentrionalis	...	r	+	r	...	...	...	...	...	...	rr	...
Nitzschia seriata	rr	...	...	...	...	...	...	...	...	...	...	...
Rhizosolenia hebetata f. semispina	...	...	...		...	...	...	...	...	...	...	...
— obtusa	...	...	...		...	...	...	...	...	...	...	...
— styliformis	rr	...	rr		...	...	...	...	r	...	rr	rr
Thalassiosira bioculata	rr	rr	...	...	rr	...	...	...	...	...	rr	...
— gravida	+	+ (c. sp. rr.)	+	+	rr	...	...	r	rr	rr	rr	r
— Nordenskiöldii	rr	...	...	...	...	...	...	rr	rr	rr	rr	r
Flagellata												
Dinobryon pellucidum	...	...	...	...	...	...	...	...	...	...	...	...
Distephanus speculum	rr	r	r	rr	...	...	...	...	...	rr	...	...
Phaeocystis Pouchetii	...	...	...	...	...	...	...	+	...	...	...	...
Coccolithophora pelagica	...	...	...	...	...	...	...	...	...	...	...	...
Pontosphaera borealis	...	...	...	...	...	...	...	...	...	...	...	...

[1] Mostly dead specimens.

1908.

25. VII	25. VII	28. VII	28. VII	29. VII	30. VII	30. VII	31. VII	31. VII	31. VII	31. VII	1. VIII	1. VIII	1. VIII	2. VIII	3. VIII
7 a.	8 p.	2·15 a.	2 p.	1·45 p.	8·30 a.	12·15 p.	11·30 a.	1·45 p.	3 p.	5.30 p.	2·15 a.	8 a.	4 p.	12·30 a.	1 p.
—	—	—	75·45	—	—	75·15	75·08	—	ca. 75·0		—	74·20	73·58	73·30	73·4
—	—	—	12·15	—	—	8·45	8.0	—	ca. 7·30		-	7·0	7·0	6·0	—
1·0	2·0	1·7	1·53	0·9	÷ 0 6	0·5	1.5	2·1	0·6		4.5	6·2	7·2	7·0	7·1
—	—	—	31·06	—	—	31·00	30.9	—	29·56		—	32.9	33·2	34·0	—
1304	1312	1319	1332	1335	1340	1344	1350	1353	1355	1358	1381	1383	1386	1388	1398
..	rr	rr	...	...	...	rr	...	...	...	...	...	..	...	...	.
rr	rr	rr	...	...	rr	...	rr	...	...	...	...	...	...	...	. .
c	+	c	...	rr	...	.	...	...	...	...	...	.	...	.	...
..	...	...	r	...	...	...	r	rr	rr	rr	rr	rr	rr	.	...
cc	c	c	r	rr	rr	rr	...	...	...	...	...	rr[1]	rr[1]	rr[1]	...
.	...	rr	...	...	r	+	r	...	...	...	...	.	...	...	...
..	...	...	cc	cc	c	c	+	...	...	...	...	+[1]	r	...	..
c	c	cc	...	...	...	...	...	...	...	...	...	.	...	...	. .
...	rr	+	...	...	...	...	rr	...	...	...	...	..	..	...	.
c	c	r	...	...	rr	...	...	rr	...	...	...	..	..	...	. .
r (c. sp. rr.)	rr (sp.)	...	rr	...	...	...	...	...	...	...	...	...	...	...	. .
r (c. sp. rr.)	rr	r	...	r	rr	...	rr	...	...	...	...	..	...	...	...
...	...	...	...	...	...	.	..	...	...	...	...	.	...	.	...
...	...	...	...	...	...	...	...	...	...	...	...	...	..	..	..
...	...	...	+	r	rr	rr	...	...	...	...	...	.	...	...	. .
...	...	...	rr	rr	rr	...	rr	...	...	...	...	.	...	.	.
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	. .
...	...	rr	...	rr	rr	rr	...	...	...	...	...	...	...	...	.
rr	rr	+	r	rr	+	+	r	...	...	...	...	...	...		...
rr	...	rr	r	+	rr	rr	...	...	...	..	...	..	...	...	.
...	...	...	rr	+	r	+	+	+	r	r	...	c	c	rr[1]	. .
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
..	..	..	rr	...	rr	...	...	...	...	...	...	+	...	...	
...	..	..	...	rr	...	...	...	...	...	...	...	+	+	. .	
...	...	...	...	...	...	rr	...	...	...	...	...	r	rr	.	.

Table III.

Date	21.VII	21.VII	21.VII	22.VII	22.VII	22.VII	22.VII	23.VII	23.VII	23.VII	24.VII	24 VII
Time	7 p.	8 p.	9 p.	11 a.	6 p.	10 p.	12 p.	5 a.	8 a.	11·30p.	10 a.	2 p.
W. Latitude	Mouth of the harbour	C. Bismarck—Marous-sia	Off Marous-sia	N. of Marous-sia	northwards along the coast			77·0	77·15	ca.78·0	ca.78·0	—
N. Longitude								17·15	16·0	c.15·30	c.15·30	—
Temperature of water	ca. 0 0			ca. 1·0	ca. 4·0	ca. 3·0	ca. 3·0	3·15	2·10	1·4	0·7	0·3
Salinity of water	31·7	31·7	31·7	ca. 30·0	—	—	—	28·06	29·36	—	28·7	—
No. of sample	1242	1243	1244	1270	1276	1279	1289	1290	1291	1299	1301	1303
Tintinnodea												
Cyttarocylis denticulata, typica	...	...	...	...	rr	rr	...	...	...	...	...	...
— — gigantea	...	...	rr[1]	...	...	...	...	r	...	...	...	...
— — robusta	...	...	...	...	...	...	...	...	...	...	...	...
Ptychocylis obtusa	...	rr	...	...	...	...	...	rr	rr	r	...	...
Tintinnus norvegicus, gracilis	...	...	...	...	...	...	...	...	...	...	...	...
Peridiniales												
Apodinium(?)Chaetoceratis	rr	...	rr	...	rr	...	...	...	...	...	...	...
Ceratium arcticum	...	rr	rr	rr	rr	rr	...	rr	rr	...	...	rr
Dinophysis arctica	...	...	...	...	...	...	...	...	...	...	...	...
— rotundata	...	...	...	...	...	...	...	...	...	...	rr	...
Goniodoma Ostenfeldii	...	...	rr	...	...	...	...	rr	...	...	...	...
Gonyaulax triacantha	...	...	...	...	...	...	...	...	...	...	...	...
— sp.	...	...	...	...	...	...	...	...	...	...	...	...
Peridinium breve	...	...	...	...	...	...	...	...	rr	rr	...	...
— brevipes	r	...	...	...	...	...	...	rr	...	...	...	...
— catenatum	rr	rr	r	...	rr	...	...	...	...	...	...	rr
— conicoides	...	...	...	...	...	...	...	rr	+	r	...	...
— curvipes	r	+	r	rr	rr	rr	...	r	r	rr	...	...
— depressum	...	rr	rr	...	...	rr	rr	...	...	...	...	...
— islandicum	r	...	...	r	...	...	...	rr	...	...	...	...
— minutum	...	...	...	...	...	...	...	rr	...	...	...	...
— ovatum	...	...	rr	...	...	rr	...	...	...	r	...	...
— pallidum	r	...	...	...	...	...	...	...	...	...	...	...
— pellucidum	+	r	r	r	...	...	...	rr	r	rr	...	...
— pyriforme	...	...	...	...	...	...	...	...	...	...	...	...
— roseum	...	r	rr	rr	...	...	...	...	...	rr	...	...
— subinerme	...	rr	...	...	...	...	...	...	...	...	...	...
Metazoa												
Calanus finmarchicus	...	+	c	r	+	c	cc	...	rr	c	...	...
Oithona similis et Nauplii	...	...	+	...	...	...	...	...	r	+	+	r

[1] Mostly dead specimens.

1908 (continued).

25.VII	25.VII	28.VII	28.VII	29.VII	30.VII	30.VII	31.VII	31.VII	31.VII	31.VII	1.VIII	1.VIII	1.VIII	2.VIII	3.VIII
7 a.	8 p.	2·15 a.	2 p.	1·45 p.	8·30 a.	12·15p.	11·30a.	1·45 p.	3 p.	5.30 p.	2·15 a.	8 a.	4 p.	12·30a.	1 p.
—	—	—	75·45	—	—	75·15	75·08	—	ca. 75·0		—	74·20	73·58	73·30	73.4
—	—	—	12·15	—	—	8·45	8·0	—	ca. 7·30		—	7·0	7.0	6·0	—
1·0	2·0	1·7	1·53	0·9	÷ 0·6	0·5	1·5	2·1	0·6		4·5	6·2	7.2	7·0	7·1
—	—	—	31·06	—	—	31·00	3·09	—	29·56		—	32·9	33.2	34·0	—
1304	1312	—	1332	1335	1340	1344	1350	1353	1355	1358	1381	1383	1386	1388	1398
..	rr	rr	r	+	+	rr	r	+	+	c	c	+	r	rr	..
...	..	...	...	.	.	.	.	.	..	...	...	...	rr	rr	..
...	..	...	.	..	...	.	rr	+	r	rr	+	r	+	r	...
rr	+	r	...	.	.	...	..	..	..	..	..	...	...	.	...
..	..	..		..	rr	...	...	...	rr	...	r	r	+	+	
...	...	...	.		...	...		...	...	...	...	..	.	...	...
rr	rr	...	rr	...	...	...	...	...	...	rr	rr	rr	+	c	c
...	...	...	rr	...	...	rr	...	...	...	rr	rr	...	rr	rr	+
		...	r	r	...	...	rr	...	...	...	...	..	...	...	rr
...	..	.		...	..	...			.	...	...	..	...	...	rr
...	...	..		..	...	...	..	..	.	...	...	...		...	..
...	.	.	...	..	...	...	...	.	...	..	...	..	...	...	...
rr	...	rr	.	...	...	...	...	...	.		...	...	...	..	.
r	...	...	...	rr	rr	...	...	...	...	...	...	...	...	r	.
...	rr	rr	...	...	...	...	...	...	rr	..	...	...			.
rr	...	r	...	r	r	rr	...	rr	...	.	...	.	..	..	..
r	r	...	...	rr	...	rr	...	...	rr	rr	...			...	...
.	...	..	rr	...	rr	...	r	r	rr	rr	...	rr	...	...	r
r	rr	...	rr	...	rr	...	rr	...	...	...	...	..	.	...	..
...	rr	...	rr	...	...	...	...	...	...	...	...	..	...	..	.
..	r	+	rr	+	r	r	+	+	+	r	r	+	+	c	+
rr	...	rr	r	r	r	r	r	rr	...	rr	rr	rr	r	+	r
rr	+	r	+	+	r	r	+	r	r	r	rr	r	+	+	.
...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	+
...	...	r	...	...	...	...	rr	...	r	.	.	...	.	...	..
...	..	.	...	rr	...	...	rr	rr	...	...	...	...	rr	r	..
...	+	...	...	...	...	...	...	...	..	..	...	...	...	...	..
rr	c	r	r	+	+	rr	c	c	c	+	c	+	c	c	..

hyperborea, small quantity of *Coscinodiscus subbuliens*, *Chaet. boreale* and *Ch. Wighami*.

The intermediate group (5 samples) extends from ca. 12° to 8° W. L.; here we have a salinity of ca. 31‰ and a surface temperature of —0·6° to —1·5° C. It is characterized by the following species, which are hardly at all found inside: *Chaetoceras furcellatum*, *Rhizosolenia obtusa*, *Rh. hebetata f. semispina*, *Dinobryon pellucidum*, *Cyttarocylis denticulata typica*. A few species, which very seldom occur in the inner group, appear here more regularly, namely, *Chaet. diadema*, *Peridinium pallidum*, *P. pellucidum* and *P. ovatum*. *Thalassiosira gravida*, which was much reduced, again becomes more frequent in this region. Most of the species prominent in the inner group disappear here or are only present in small quantity.

A couple of samples form the transition to the outer group, to which we ascribe the region from ca. 7° to 6° W. L. and from 75° to 73° N. L. The salinity is here higher (33—34‰) and also the temperature on the surface (6°—7°) than in the other regions; we are here outside the pack-ice. The quantity of the plankton is but small; the diatoms have almost entirely disappeared; characteristic however is the regular occurrence of *Chaetoceras convolutum* in small quantities; further, a number of diatoms of more temperate origin appear irregularly and in few individuals and likewise some Protozoa (see our preceding papers). The most abundant organisms are: *Peridinium ovatum*, *Dinobryon pellucidum*, *Cyttarocylis denticulata typica* and *robusta*, *Oithona* and Nauplii, and in most samples *Ceratium arcticum*, *Tintinnus norvegicus gracilis* and *Peridinium pyriforme*. In a few samples occurred *Phaeocystis Pouchetii*, *Pontosphaera borealis* and *Coccolithophora pelagica*.

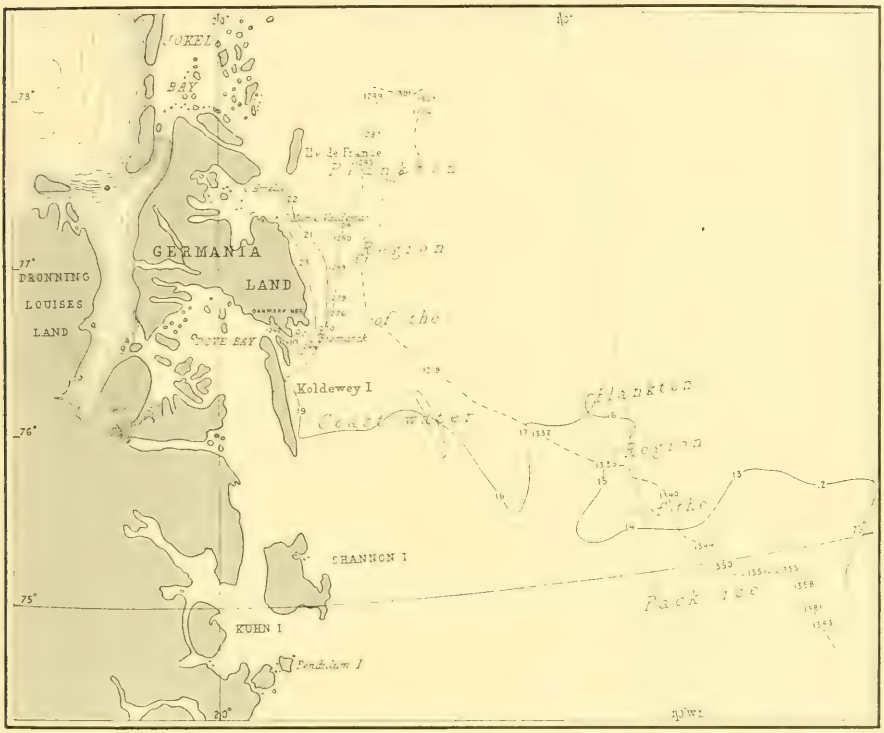
The plankton in the outermost samples corresponds nearest to the "Ceratium arcticum plankton", which Paulsen (1909) has described from North Iceland (the southern boundary of which is placed at ca. 64 N. L. in his fig. 2), but differs from this in the absence of *Ceratium longipes* (the *C. arcticum* most resembling *longipes* is figured in the foregoing paper fig. 16 A).

A general review of the plankton of the pack-ice and coastal waters, according to the samples examined, would appear somewhat as follows. In the accompanying sketch map the plankton regions and the places of the samples (the figures refer to the Tables) have been marked out. There are three regions.

1. Innermost the plankton region of the coastal waters (inner group in 1906 and 1908), characterized by diatoms, namely *Chaetoceras* species, *Coscinodiscus subbuliens*, *Fragilaria oceanica* and by *Calanus finmarchicus*.

2. The plankton region of the pack-ice (outer group in 1906, intermediate group in 1908), characterized by *Cyttarocylis denticulata, Rhizosolenia hebetata semispina* and *R. obtusa, Chaet. furcellatum, Peridinium subinerme, P. pellucidum* and *P. curvipes*, and *Dinobryon*.

3. The plankton region of the open water (outermost group in 1908) with small quantities of characteristic species: *Cera-*



Sketch-map of the area investigated. The full line signifies the path of the Expedition into the coast, the broken line the way out. The figures refer to nos. of samples in the plankton tables.

tium arcticum, Peridinium ovatum, (*Pontosphaera borealis* and *Coccolithophora*?).

There is the probability that the plankton region of the pack-ice corresponds to the East Icelandic Polar Current, whilst the plankton region of the coastal water corresponds to the coastal waters mixed with water from the melting snow of the land. Lastly, the plankton region of the open sea may probably be referred to the circulating central area of the Greenland Sea. This agrees with what Damas and Koefoed say (l. c. p. 328): "les diatomées qui seules jouent un rôle important dans le phytoplankton, prennent un deve-

loppement beaucoup plus considérable dans le courant polaire que dans la région centrale de la Mer du Groenland".

We must remember here, however, that our knowledge of the plankton of these waters is restricted to the summer season.

We may remark, finally, that oceanic plankton forms, e. g. *Rhizosolenia styliformis*, *Certium arcticum*, are carried right in to the coast, where they may be considered to perish sooner or later.

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14.—3.—1911.

XII.

CONTRIBUTIONS TO THE CARBONIFEROUS FLORA OF NORTH-EASTERN GREENLAND

BY

A. G. NATHORST.

1911.

Occurrence of the plant-fossils.

The discovery of a carboniferous flora in the area between 80 and 81 degrees of northern latitude on the east coast of Greenland is of special interest from a palaeobotanical point of view. This flora represents the most northern carboniferous flora hitherto known, the corresponding plant-bearing deposits of Spitsbergen being all situated south of the 80th degree. In consequence of the circumstances — long sledge-journeys — during which the materials were collected the collection is naturally not comprehensive: nevertheless it contains specimens of interest. It certainly also promises rich harvests in the future if the deposits in question are examined with the chief object of gathering fossil plants.

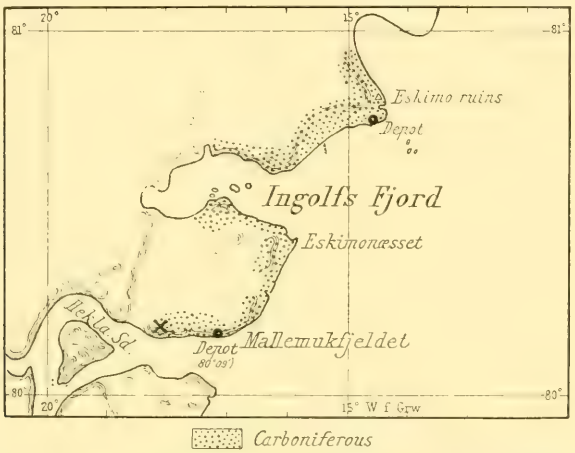

Fig. 1. Sketch-map of the east coast of N. E. Greenland between 80° and 81° N. L. showing the position and extension of the carboniferous rocks.

As to the geological position of the plant-bearing strata Mr. H. Jarner, the geologist of the expedition, has sent me the following communication, regarding which, however, it ought to be mentioned that Mr. Jarner has not seen any of the carboniferous localities himself but owes his information to Messrs Koch and Wegener, the former of whom has travelled along the outer coast, while Mr. Wegener visited Hecla Sound and Ingolf Fjord.

The carboniferous deposits occur on the coast outside the Archaean rocks. They here form a plateau, the height of which at the outer coast measures about 500 meters, while it is somewhat

lower inwards in consequence of the gentle slope of its surface to the westward. The Archaean rocks west of the carboniferous deposits rise to their usual height of about 1000 meters.

There is a gentle dip of the carboniferous strata towards the east and north, and the oldest deposits are consequently found at the western boundary of the formation. On the northern side of Hecla Sound (at × on the little sketch-map text-fig. 1) there were collected some impressions[1] in loose slabs of a micaceous slate at the base of the mountain, probably originating from a similar rock which forms the lowest accessible part of the mountain-side and which is intercalated with and covered by a fine shale without fossils. The slate also includes some strata, mostly thin, of a reddish sandstone.

As the dark, almost black, colour of the shale prevails up to the summits of the mountains it is supposed that these wholly consist of this same rock, the thickness of which consequently must be about the same as the height of the mountains or 300 – 400 meters (as minimum).

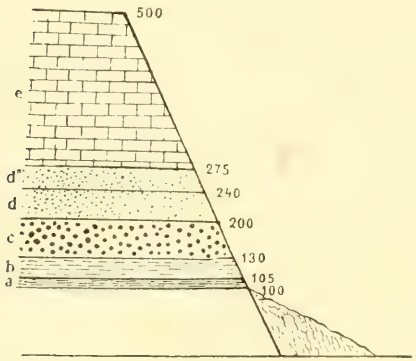

Fig. 2. Section of the carboniferous rocks at the Depot 80° 9′. (a), fine and soft black shale; (b), grey shale; (c), conglomerate; (d), sandstone without fossils; (d″), fossiliferous sandstone; (e), limestone rich in corals.

About 7 kilometers east of this locality, namely at "the Depot 80° 9′", the following section was measured (text-fig. 2). From the foot of the mountain up to 100 meters above sea-level the rock is hidden by loose debris, but at the height mentioned the shale again presents itself as an almost black stratum 30 meters thick. This stratum is composed of alternating beds of a grey somewhat coarser shale (b) and a black fine and soft one (a) which is especially prevalent in the lower part (about 5 meters). The shale is covered by a conglomerate of dark red colour (c), which now prevails up to 200 meters above sea-level. The pebbles of this conglomerate are well rounded and very small, their size being about that of a hazel-nut, but even this gradually diminishes upwards so that the conglomerate gradually passes into a red sandstone, which forms the rock until a height of 275 meters above sea-level is reached. The grain of this sandstone varies, coarser or finer, as also does the colour: red, white

[1] Knorria-form of Lepidodendron. A. G. N.

or, sometimes, almost black. The lowermost part of the sandstone (d) contains no fossils, but from 240 to 275 meters (d″) there is an abundance of them, especially brachiopods. From 275 meters up

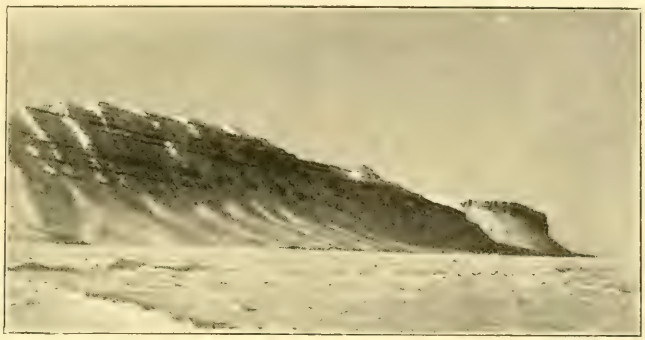

Fig. 3. Coast between "the Depot 80° 9′" and "the Mallemukfjeld".

to its summit (probably 500 meters) the mountain is composed of a dense limestone (e) rich in corals.

According to the dip of the strata (fig. 3) the uppermost layers at the Depot 80° 9′ form the base of the Mallemukfjeld. That mountain (about 500 meters high, fig. 4) also being built up of limestone, the total thickness of this rock is estimated as at least 700 meters.

No faults have been observed within the carboniferous formation.

Fig. 4. The Mallemukfjeld.

From this communication of Mr. JARNER's it is evident that the plant-bearing beds occupy the base of the carboniferous deposits of N. E. Greenland, the whole formation being probably a downthrown block outside the boundary-fault of the Archaean "Horst". Their

stratigraphical position is consequently analogous to that of the plant-bearing carboniferous beds of Spitsbergen, the age of which, as shown by me long ago[1], is lower carboniferous. As will be seen below, this is also the case with the plant-bearing carboniferous beds of North-eastern Greenland.

Description of Species[2].

Filicales.

Rachises of ferns (or pteridosperms).

Pl. XV, Figs. 1—4.

Although naturally these rachises cannot be specifically determined, yet I have thought it convenient to have some of them figured. The specimen fig. 1 is striated longitudinally, as is also the case with many specimens from Spitsbergen, while the specimen fig. 2 is characterised by small spines or tubercles, as is pretty common with palaeozoic ferns or pteridosperms.

Calymmatotheca bifida Lindley & Hutton sp.

Pl. XV, Figs. 5, 6.

Only the two specimens figured (and also the counterpart of fig. 5) have been found; but they are too characteristic to leave any doubt as to the correctness of the determination, for they agree in every point with specimens from Spitsbergen[3].

Sphenopteris sp. indet.

Besides the species just mentioned, there occurs also another relic of the *Sphenopteris*-type, the small pinnules of which seem to have had a somewhat triangular shape. The outlines however are too obsolete to allow of any determination whatever.

[1] A. G. Nathorst, Zur paläozoischen Flora der arktischen Zone, Stockholm, Vet. Ak. Handl., Bd. 26, No. 4. 1894. Beiträge zur Geologie der Bären Insel, Spitzbergens und des König-Karl-Landes. Upsala, Bull. Geol. Inst., Vol. X. 1910.

[2] In this short notice I have not found it necessary to give any lists of synonymy but have only cited such works which are of special interest for the comparison with the species here mentioned.

[3] Nathorst, Zur paläozoischen Flora der arktischen Zone. l. c. p. 19, Taf. III, Figs. 1—3.

Sphenophyllales.

Sphenophyllum tenerrimum Ettingshausen var. elongatum D. White.

Pl. XV, Figs. 11—22.

The collection contains several stem-fragments and some leaves of a small *Sphenophyllum*, which belongs to the *tenerrimum*-type. It differs, however, from this species by the somewhat larger size of the verticils and by the leaves being more divided and often petiolated; the internodal parts of the stems are generally longer than those of the typical *Sphenophyllum tenerrimum*. Dr. R. Kidston has kindly called my attention to the variety *elongatum* described by Dr. D. White[1], and as far as concerns the verticils there seems indeed to be a complete accordance with the Greenlandic plant[2]. As Dr. White says nothing about the length of the internodes, I have not been able to ascertain if there is coincidence in this respect also, but this is of little importance since a difference in this point may be due to the outer conditions under which the plants have grown.

Calamariales.

Asterocalamites scrobiculatus Schlotheim sp.

Pl. XV, Figs. 7—10.

Only two fragments — the specimens fig. 7 and fig. 9 — both on the same slab, have been found; and it is probable that these have originally belonged to the same individuum. The specimen fig. 7 represents a compressed stem about 18 millimeters in diameter with pretty distinct longitudinal ribs, in the middle of which there is a furrow (figs. 8, 10). No nodal lines are to be seen, but the nodes are indicated by the ribs being somewhat "swollen" at regular intervals (at *a*, *b* and *c* fig. 7). At *c* the node is also very clearly indicated by the arrangement of the fine striae between the ribs as distinctly seen under the microscope (fig. 8). The small fragment fig. 9 (magnified fig. 10) represents a part of the surface at the node with the "swollen" ribs.

According to a kind communication by Dr. Kidston, the nodes of *Asterocalamites scrobiculatus* "are sometimes not distinguishable, from the absence of a definite line, but they are often indicated by swollen or gently uprising protuberances".

[1] D. White, The stratigraphic succession of the fossil floras of the Pottsville formation in the southern anthracite coal-field, Pennsylvania. In the 20th Ann. Rep. U. S. Geol. Survey. Washington 1900.

[2] When only leaves and no stem-fragments are present it may be difficult to decide if the leaves belong to this type of *Sphenophyllum* or to *Asterocalamites*.

The occurrence of this species in N. E. Greenland is of particular interest, since no Calamarialian remains have been hitherto found in Spitsbergen.

Lycopodiales.

Lepidodendron spetsbergense Nathorst.

Pl. XVI, Fig. 24.

Part of a branch in pretty good preservation which perfectly agrees with corresponding branches of the same fossil from Spitsbergen (NATHORST, l. c., p. 37, Taf. VII, 1—7; IX, 3; X, 14, 15),

Lepidodendron sp.

Pl. XVI, Fig. 25.

This is a *Knorria*-form of some *Lepidodendron* which, although not determinable, is thus far of importance as it proves the occurrence of another species besides *L. spetsbergense* in the carboniferous flora of N. E. Greenland.

Lepidodendron sp.

Pl. XVI, Fig. 26.

An inner surface of the cortex of some *Lepidodendron*, possibly belonging to one of the species mentioned above, the chief interest of which is that it indicates the presence of big individuals of the genus also in this northern latitude.

Lepidodendron? sp.

Pl. XVI, Fig. 27.

A very small twig with short leaves, which is naturally not determinable. It has a close resemblance to similar twigs from Spitsbergen which were named by HEER *Lycopodites filiformis*[1], but which may just as well belong to some *Lepidodendron*. The leaves of the Spitsbergen-plant, however, seem to be somewhat more acutely pointed.

Lepidophyllum cfr. lanceolatum Lindley & Hutton.

Pl. XVI, Figs. 28—33, 36.

These sporophylls form the most common specimens of the fossils collected and were obtained from different localities. They

[1] O. HEER, Beiträge zur fossilen Flora Spitzbergens, p. 11, Taf. III, Fig. 23—25. Stockholm, Vet. Ak. Handl. Bd. 14, No. 5. 1876. Also in Flora fossilis arctica. Vol. IV.

all belong to the *lanceolatum*-type of LINDLEY & HUTTON[1] and the sporangium is often found still adhering to the sporophyll. On some of the sporangia the impressions of the spores from the inside can be seen.

Dr. KIDSTON informs me that he gets similar *Lepidophylla* both in the lower and upper carboniferous and that they are of no use for zonal purposes. No corresponding form, however, has yet been obtained from Spitsbergen.

Several of these *Lepidophylla* show curious markings on their surface (figs. 28, 29, 31), which seem to indicate that there has been some adhering organism when they were floating in the water. The markings are more intricate than the *Spirorbis* adhering to carboniferous plants. As to the organism to which they are due I have no opinion whatever.

Whether the two specimens figs. 34 and 35, which are seen in profile and the sporangia of which are relatively great, belong to the same species as the others, is difficult to ascertain; but I suppose that such may be the case.

The specimen fig. 37 represents rather a leaf from a branch than a true sporophyll.

Stigmaria ficoides Sternberg sp.

Plate XV, Fig. 23.

Only the small fragment figured represents the *Stigmaria* in the collection.

Summary.

As to the distribution of the different species within the strata, the material is too poor to allow of any conclusions. The following list, however, gives some information about the localities or strata where the fossils here described have been found. 1 indicates the lowermost stratum (*a*) of the shale in the section fig. 2, while 3 is one of the intercalating strata of the somewhat coarser shale (*b*) of the same section. 4—6 are specimens collected about 100 meters eastward from the locality just mentioned: 4 from a loose slab found about 115 meters above sea-level, 5 from the shale *in situ* 90 meters, and 6 from loose materials 90—115 meters above sea-level. 10 and

[1] LINDLEY & HUTTON, The fossil Flora of Great Britain. Vol. I, pl. 7, figs. 3—4. London 1831—33.

11 were found as loose slabs below the outcrop of the older strata in the western part of Hecla Sound.

Occurrence of the species in different localities	1	3	4	5	6	10	11
Calymmatotheca bifida L. & H. sp.	..	..	..	+	+	..	..
Sphenophyllum tenerrimum Ett. var. *elongatum* D.W.	..	..	..	+	+	..	..
Asterocalamites scrobiculatus Schloth. sp.	..	..	..	..	+	..	..
Lepidodendron spetsbergense Nath.	..	..	+	..	..	..	..
— (*Knorria*) *sp.*	..	..	..	..	..	+	+
— *sp.* (fig. 26)	..	+	..	..	..	..	..
— *sp.* (fig. 27)	+	..	..	..	..	..	..
Lepidophyllum cfr. lanceolatum L. & H.	+	..	..	+	+	..	..
Stigmaria ficoides Sternb. sp.	..	+	..	..	..	..	..

As to the age of the plant-bearing deposits as a whole, there can be no doubt that this must be lower carboniferous. For such an opinion the occurrence of *Calymmatotheca bifida* and *Lepidodendron spetsbergense* as well as that of *Asterocalamites scrobiculatus* may be cited; and none of the other plants speak in an opposite direction. This is all that can be said at present, the materials being too scanty to allow of any more detailed conclusions. Owing to the great thickness of the plant-bearing beds it is probable that a more minute examination, from a stratigraphical point of view, will prove that several plant-bearing horizons may be distinguished.

PLATE XV.

PLATE XV.

Fig. 1— 4. Rachises of ferns (or pteridosperms).

— 5, 6. *Calymmatotheca bifida* L. & H. sp.

— 7—10. *Asterocalamites scrobiculatus* Schloth. sp. 7, fragment of the stem with 3 nodes (at *a*, *b* and *c*); 8, part of the node at *c*, magnified; 9 part of the surface of another fragment with the "swollen" ribs at the node; 10, the same as fig. 9 magnified.

— 11—22. *Sphenophyllum tenerrimum* Ett. sp. var. *elongatum* D. White. 11—16, fragments of stems; 17, 18, stem-fragments with remains of leaves at the nodes; 19, the same as fig. 18, magnified; 20, part of a verticil; 21, two verticils still adhering to the stem; 22, one of the leaves of fig. 21 magnified.

— 23. *Sligmaria ficoides* Sternb. sp. Fragment.

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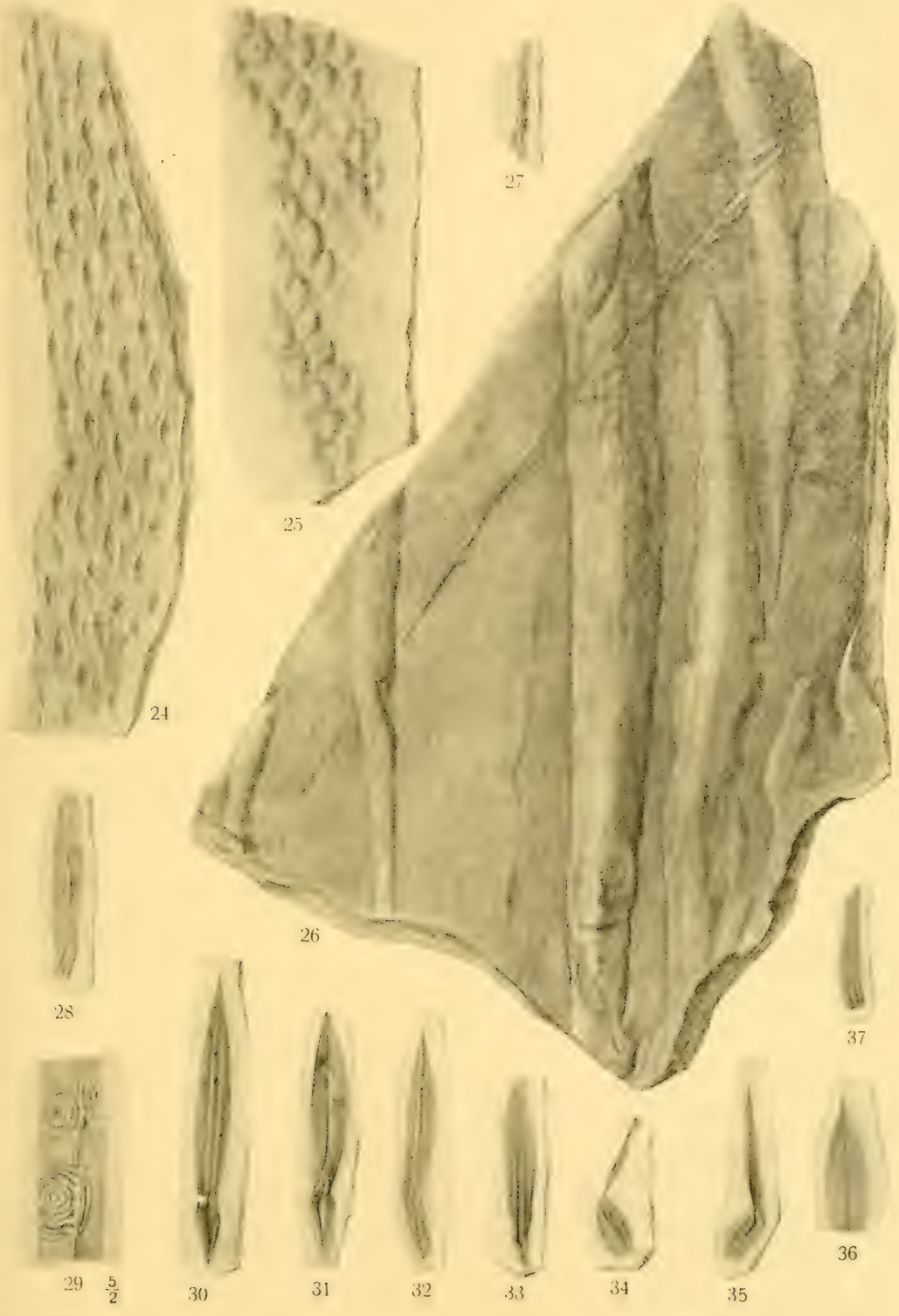
Cederquists Graf. A.-B., Sthlm.

PLATE XVI.

PLATE XVI.

Fig. 24. *Lepidodendron spetsbergense* Nath. Part of a branch.
— 25. *Lepidodendron sp.* (*Knorria*-form).
— 26. *Lepidodendron sp.* Inner cortical surface.
— 27. *Lepidodendron? sp.* Small twig.
— 28—36. *Lepidophyllum cfr. lanceolatum* L. & H. Note the markings on the specimens figs. 28, 29 (magnified) and 31. It is not quite certain whether the specimens figs. 34 and 35 seen in profile belong to the same species as the other ones.
— 37. Leaf of *Lepidodendron.*



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Cederquists Graf. A.-B., Sthlm.

XIII.

SOME NOTES CONCERNING THE VEGETATION OF GERMANIA LAND, NORTH-EAST GREENLAND

BY

ANDR. LUNDAGER

WITH A MAP (PL. XVII)

1912

I. Climatic conditions at Danmarks Havn. 1906—1908.

Temperature. The mean temperature in the first year was — 13.1°, in the second year — 12.0°, for both years — 12.6°. (According to Mohn's chart of the isotherms of the year it should be about — 12.0°; the Germania Expedition gives — 11.7° for the Island of Sabine).

The mean temperature and the extremes for the months were: —

	1906					1907						
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July
Mean	+ 2.1	— 3.7	— 14.5	— 21.0	— 24.6	— 23.0	— 26.0	— 23.7	— 19.4	— 8.2	+ 1.1	+ 3.3
Maximum	—	+ 10.2	+ 0.2	— 8.5	— 12.2	— 3.4	— 16.4	— 12.4	— 9.1	+ 5.0	+ 7.7	**+ 12.3**
Minimum	—	— 13.0	— 23.8	— 34.0	— 34.4	— 36.4	— 35.9	**— 40.9**	— 30.1	— 22.0	— 7.5	— 2.0

	1907					1908						
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July
Mean	+ 2.3	— 4.4	— 14.6	— 19.7	— 17.2	— 20.8	— 28.9	— 21.1	— 19.6	— 6.4	+ 1.1	+ 5.4
Maximum	+ 12.2	+ 2.8	— 2.5	— 9.4	— 0.6	— 6.6	— 26.4	— 1.4	— 3.5	+ 3.0	+ 11.6	**+ 17.1**
Minimum	— 6.0	— 14.5	— 23.3	— 32.1	— 33.8	— 33.5	**— 38.3**	— 36.2	— 33.7	— 22.3	— 9.3	—

The seasons of the year: —

Autumn (Sept.—Nov.)	— 13.0
Winter (Dec.—Feb.)	— 23.4
Spring (March—May)	— 16.4
Summer (June—Aug.) ...	+ 2.6

Number of days on which the mean temperature was above 0°: —

Aug. 06—July 07 ...	89 days
Aug. 07—July 08 ...	76 —

Days without frost: —

Aug 06—July 07 ...	31 days
Aug. 07—July 08 ...	38 —

Days with frost (temp. usually above 0°, but minimum below or = 0°): —

Aug. 06—July 07 ...	73 days
Aug. 07—July 08 ...	69 —

Ice-days (temp. constantly below 0°): —

Aug. 06—July 07.. 261 days
Aug. 07—July 08.. 259 —

N.B. Reasonable values have been calculated and added to compensate for the first half of Aug. 1906 and for the latter half of July 1905, both of which were wanting, so that the figures, throughout, apply to complete years.

Precipitation in mm. of water (based partly upon measurements and partly upon a rough estimate).

The totals for the months and the years: —

	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Year
1906—07	0.0	6.0	10.7	13.6	20.3	27.1	23.5	23.1	4.4	2.8	10.2	1.9	143.6
1907—08	16.1	8.9	2.2	38.3	17.4	33.9	11.5	12.7	0.8	5.0	0.6	0.0	147.4
	(The figures must not be regarded as strictly accurate.)												
Mean ...	8.0	7.4	6.4	26.0	18.8	30.5	17.5	17.9	2.6	3.9	5.4	1.0	

Summer (April—Sept.) 28.4
Winter (Oct.—March) 117.2

Consequently, 4/5 of the total amount of precipitation must be reckoned to the winter half-year. Not even 1/10 of the precipitation of the year falls as rain.

The first rain of the year fell in { 1907 on June 25
1908 - — 17

and the last rain fell in { 1906 on Sept. 25. (Very exceptional; the temp. of the air being —10°.)
1907 - Aug. 22

Number of days with downpour.

	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Year
1906—07...	0	9	11	9	11	14	12	13	7	7	8	6	107
1907—08...	12	2	5	15	16	21	8	9	5	10	4	0	107

According to the seasons of the year: —

	1906—07	1907—08
June—Aug.	14	16
Sept.—Nov.	29	22
Dec.—Feb.	37	45
March—May	27	24
Summer (April—Sept.)	37	33
Winter (Oct.—March)	70	74

Consequently, the winter half of the year has twice as many days with downpour as has the summer half of the year.

II. Vegetation-conditions.

When the Danmark Expedition arrived at Cape Bismarck in the middle of August 1906, it was already autumn from a floristic point of view. During the excursions to Stormkap and Hvalrosodde at the end of the month, it was only late-flowering species which were found just in the act of expanding, or else those, whose flowering-period extends over the whole of the summer according to the different localities in which they occur. Among these may be mentioned especially *Ranunculus glacialis* on damp gravelly flats beneath the melting snow-drifts (*Dryas octopetala* also, in part), as also *Pedicularis hirsuta*, *Ranunculus sulphureus* and *Papaver radicatum*. In damp river beds *Oxyria digyna* is usually conspicuous, with its red leaves and purple-coloured nuts.

The *Dryas*-tufts are standing quite brown upon the primitive rocks and are so dry that the leaves crumble between the fingers; at the same time — on August 24 — still luxurious mats of *Dryas* are to be found upon a slope with a southern aspect where the melted snow of drifts from higher altitudes provides sufficient moisture for the nourishment and necessities of life of these stragglers. *Cassiope tetragona*, also, has now finished flowering and is quite brown and dry. Along the large Lakseelv, on the northern side, near high-water mark, *Saxifraga oppositifolia* stood in full bloom, as also a few individuals of *Taraxacum phymatocarpum* and *Lesquerella arctica*. The *Cyperaceæ* also have finished flowering and are withering except near the water-courses. In a few damp places a flowering specimen of *Silene acaulis* may yet be seen and near the shore, *Statice armeria*; but a little higher up that also is decaying.

Upon Fuglenæbsfjæld, at an altitude of about 300 metres, *Arnica alpina*, *Potentilla nivea* and *Melandrium affine* were found in flower, while *Stellaria longipes* had not yet reached that stage. The locality was a rock-ledge with a humus-like substratum, south-east exposition and sheltered towards the north and west. Upon a level gravel-field percolated by melting snow, *Saxifraga oppositifolia* was found flowering; not until then, when it was released from its snow-covering, did it have its spring.

As seen from the table (p. 350), the amount of precipitation is on the whole inconsiderable, but least during spring and autumn.

On September 18, 1906, the percentage of moisture in the air was recorded to be 44'. The result of a dry autumn is thorough desiccation of the soil before the snow-covering comes, and this circumstance is of vital importance to the vegetation. Not until September 24 does snow come, and the temperature is constantly relatively high. The minimum, — 13.0° — is not reached until the end ot the month; no regular snowstorm occurred until October 22nd.

At New Year there is only a thin covering of snow in the district around Danmarks Havn.

All the level areas of the rocky flat proper are nearly free from snow, and consequently the vegetation there has no protection against the wind and weather. It is of common occurrence that the winter snow is carried away by the wind and forms drifts on the leeward of rocks. From the level ground on the rocky flat the snow disappears almost entirely after the first storm of wind which closely follows the snowfall when it does not accompany it; at any rate in such places the snow does not remain long enough to confer humidity upon the soil during spring. In bogs and meadows, in so far they may be called meadows, the circumstances are somewhat different; here the snow finds shelter and is able to form a rather considerable layer, the thickness of which varies according to the character of the vegetation. In places where the latter is dense and covers the ground entirely, the uppermost dead apices of grasses and Cyperaceæ protrude above it and lie prostrate upon its surface in the direction of the prevailing wind, NW.—SE. Where the ground is uneven by erosion and has isolated boulders, the surface appears dark seen from the NW. while the snow is lying on the leeward towards the south. Everywhere along the hill-sides large snow-drifts occur, and they condition the life of the vegetation upon the more level areas lower down, *Eriophorum*-bogs (Fig. 1) being usually formed if the gradient is favourable, so that the water may find outlets. Above such bogs, areas are often found which are not laid bare by the melting of the snow until late in summer, and there a barren slush of clayey mud only is formed.

Inwards in the bay, on Hvalrosodde which I visited on January 4, 1907, the extensive area along the river is also free from snow. It consists of moraine formations with an almost level surface, of which the entirely flat areas are quite snowless; here *Statice armeria* stands quite unprotected. Only the small channels formed by melted snow afforded a shelter for the snow beneath which *Cassiope* lies

Fig. 1. Landscape to the north-west of Danmarks Havn. Varderyggen, with remains of snowdrift in shelter, is seen in the background.

in its winter-sleep. At Hvalrosodde the gravel and the sand is so dry and loose that the frost is not able to bind it.

On January 7, 1907, the ground is for the first time covered by loose snow — everywhere.

On April 5 the Snow Bunting arrived; but not until the 23rd can the weather be said to have grown milder. On that day I saw two Buffon's Skua in the bay betwen Cape Amélie and Cape Marie Valdemar. Off Isle de France there was open water.

Even now evaporation is in full activity and consequently the mountain darkens from day to day.

On May 24 we have for the first time a positive temperature; six days afterwards the thermometer records above 0° at all three readings.

At the end of May, with the commencement of the higher temperature, we have also other common spring phenomena; small gatherings of water begin to appear in Basiskær and on the 20th, *Saxifraga groenlandica* flowers on Termometerfjeld — beneath a "pane" of ice.

From Hvalrosodde open water is recorded along the shore of a lake near Lakseelv. At Danmarks Havn, before June, only a few boulders had become visible by the melting of the snow along the margin of Drikkevandssø.

On June 4 *Saxifraga oppositifolia* is in flower, but only here and there and not quite expanded. The next day it is found flowering commonly at Stormkap, and on the same day flowering individuals are also met with at Termometerfjeld.

There are now in a great many places small, open tarns, where wading birds rest in their journey.

In the night previous to the 3rd of June the large flight of birds occurred just at the point of time when the door of the cupboard was thrown wide open. As we know, these pools contain swarms of living creatures such as larvæ and other creeping things which condition the existence here of small wading birds. It is quite a peculiar experience to be out on a night when the flight of these birds takes place. The air is full of the music of their notes and of the whirr of wings. I was on my way to Stormkap in the night in question with a hand-sledge, so for several hours I had a good opportunity of hearing the winged crowds as they made towards land to their breeding places, where the flocks separate.

Out on the ice a bear was lying with its two cubs and was devouring a seal which it had caught at a breathing-hole. This meal was watched over with apparent interest by foxes and ravens,

and spying gulls who, seated upon the neighbouring icebergs, waited for the moment when the lawful owner of the prey should retire.

On the 4th the minimum thermometer recorded for the first time a positive temperature; soon afterwards we had east winds which again for some days brought the thermometer down below freezing point.

On June 10 we have snow and wind with a high, almost positive, temperature the whole day.

Under such circumstances the snow which has fallen benefits the whole surface of the ground, as it is now allowed to melt where it lies. Seen from Termometerfjeld the ground down towards Skibshavn was white at noon; but before long the soil, already somewhat thawed and sun-heated absorbs the melting snow. In contradistinction to a considerable part of the winter-snow, which disappears by evaporation early in spring and leaves behind it only a dry bottom, this summer-downfall penetrates easily to the roots of the plants, which are just now in want of it.

On moss-tufts and other plant-carpets there is not the slightest indication of dampness from evaporating snow. But, on the other hand, the fresh verdure of both the moss and the lichen now show that they have benefited by the moisture from above. The boggy stretches are also now so far thawed that the plant-life there can begin to awaken; already some days ago drinking-water had been fetched from a small streamlet near Basiskæret.

The weather was also quite summer-like on June 13 when I made an excursion to Hvalrosodde. The surface was in a bad state a great part of the way and especially the last part where the melting snow had already formed large ponds upon the ice. In the bay off the mouth of Lakseelv the wind had covered the ice with a rather considerable layer of dust and sand from the lowland above and this furthers, in a high degree, the melting of the snow, so that both the number and the depth of the pools were greater here than farther from land. And the conditions grew perceptibly worse day by day. At 3 p. m. the temperature (measured by a swinging thermometer) was + 12.4°. From the fore-shore (Fjæren) we had driven our sledges so far into the land, that they just touched the snowless ground; then we stopped to pitch our tents. But now the snow retired so quickly down towards the fore-shore that it was almost noticeable from hour to hour how the distance increased, and although, in the following days, we had fog and a lower temperature, yet several metres of the way to the ice was bare of snow when we left the place on the 17th.

In the lower part of the bed of the Lakseelv, which is at this

point from 40 to 45 metres broad, the snow was yet lying deep, but there were a few pools here and there; higher up it appeared as if a single spot was free from ice and in this opening in the ice several swimmers (loons) lived.

In a pond formed from melted snow, the temperature of which measured + 16.4°, *Oxyria digyna* was seen with large, fresh, leafy shoots and a *Statice* with an almost fully developed flower-bud. On dry ground, on the other hand, *Oxyria* develops flower at the expense of its leaves — the reverse is found to be the case in *Statice*. In spite of the falling temperature, + 7.5° was measured at 8.30 p. m. in a larger lake. Around the tenting-place stood crowds of *Saxifraga oppositifolia* in bloom. At night the temperature went down to below 0°. The whole of the next day there was a dense fog, so dense that tent-ropes were covered with rime, and the swinging thermometer also became covered with ice during use; the following night the temperature went down to — 2.0°. Not until late in the day, on the 15th, did the fog disperse by a fresh breeze from the NW.

As it might be of great interest to see spring advance toward the head of the fjord I tried to reach Fuglenæbsfjæld, near a spot which I had visited at the end of August the previous year; but already off Rypefjeld, about 10 km. from Hvalrosodde, the sledge was stopped by a crack in the ice; and as it was not possible to proceed further by the sledge, I went ashore there. Upon sloping ground, copiously watered by melting snow, one of the usual *Eriophorum*-bogs was formed (Figs. 1, 2). Here masses of lumps of *Nostoc* were lying, and here *Eriophorum polystachyum* was found already in flower. Around Danmarks Havn the species was not seen flowering until the end of the month. Next day when I visited "Trekroner" I found *Draba arctica* (J. Vahl) in flower while it was not seen flowering at Danmarks Havn till the 22nd. As might be expected, these few features indicate an earlier spring in the interior of the fjords than down by the coast.

Unfortunately the conditions on the ice were such that they compelled me to retreat early so I had to limit my excursions to a single visit to "Trekroner" on June the 16th.

This rather formidable mass of rocks forms the eastern boundary of Sælsö; it consists of three elevations, separated by valleys, with surfaces consisting of boulders and large stones with intervening, flattened areas covered by the products of weathering. Strangely enough, I found up here *Trisetum*, which in the coastal region is only found on sheltered rock-ledges with a snow-covering of long duration. But a similar snow-covering may probably also be found

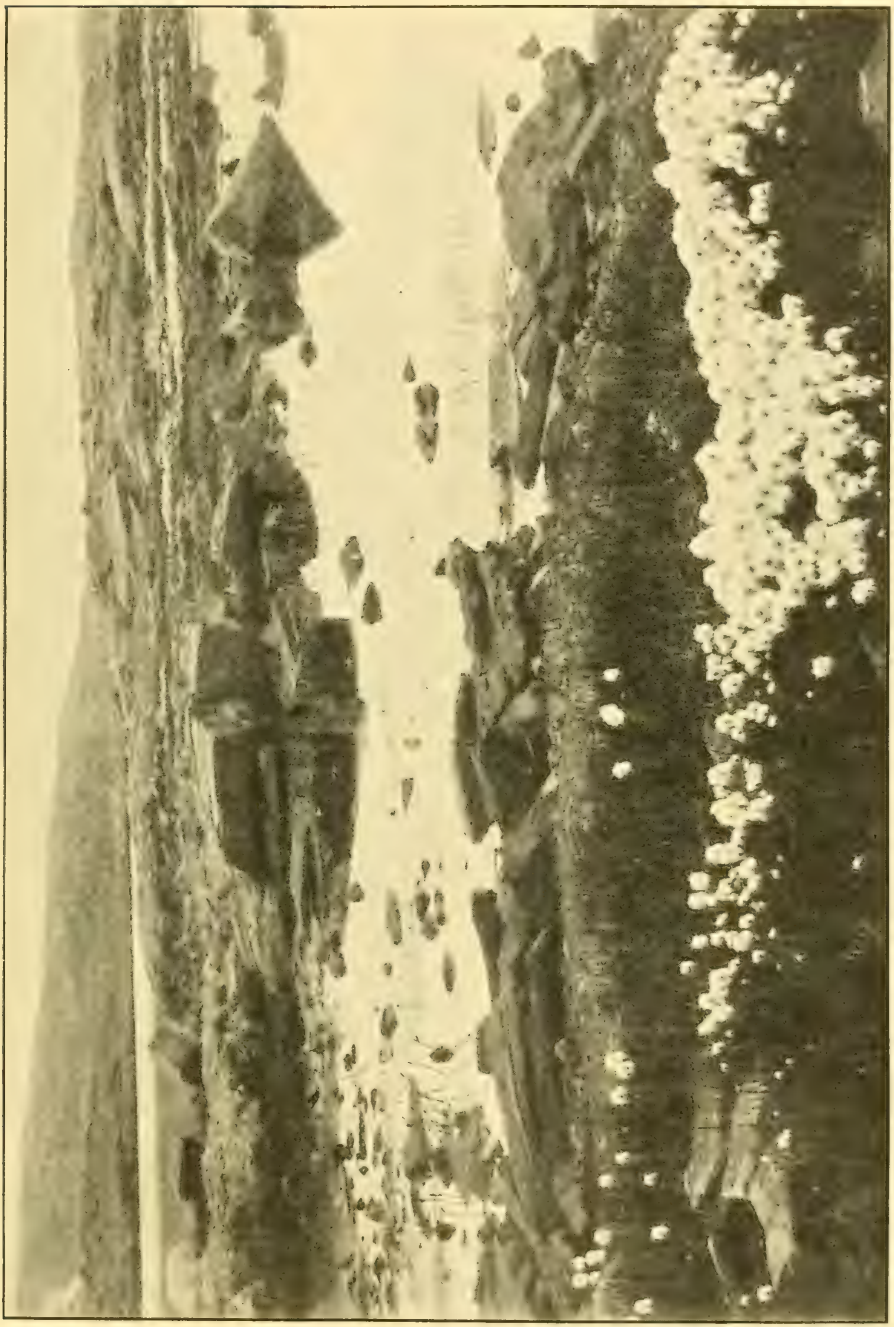


Fig. 2. View of a small lake with *Hippuris vulgaris* in the lake, to the left. In the foreground associations of *Eriophorum Scheuchzeri* and *E. polystachyum*.

here on the small patches of gravel in the shelter of larger and smaller loose stones. Upon the south-west side of the mountain, facing the lake, the most favourable conditions for the vegetation exist which can on the whole be found in the district traversed. Seen from a distance there is here in reality a vegetation which reminds one of heather-moors (cf. Warming, "Lynghede" in Meddelelser om Grønland, XII, 1887). *Cassiope* is the most dominant plant (Fig. 4); it imparts a dark tone to the rocks. At nearer approach the numerous, small rippling half-hidden streamlets from the more elevated snow-drifts are distinctly heard. Upon the rather steep rocky slope, where these tiny murmuring brooklets cut their way into the layer of moorland soil, one also meets with strips of continuous greensward, apparently consisting principally of species of *Carex* which, however, cannot be determined at this time of the year. If anywhere anything could be reminescent of "grassy slopes" ("Urteli") it would be here where certain spots open a possibility for the formation of humus. A slight depression between the stones easily becomes filled with withered plant-remains and the dung of the hare and the ptarmigan — a fitting nursery for saprophytic fungi. When these loose materials are removed many tender young shoots, as might be expected, are found in a soil penetrated by plant-roots; but it is not the tender or the frail species which have here been permitted to occupy the best localities. So far as the contents of the spirit-jars from this locality could be determined, it was, as from the corresponding localities nearer the coast, *Campanula* and *Polygonum* which principally cover such relatively favourable small patches of the otherwise hard and poor rocky flat.

Besides the above-mentioned species, *Draba glacialis* flowered here on June 16; but already two days earlier it had been found flowering in Lambert Land (79° 8′). *Hierochloë* also stands here, broad and strong, with open anthers. In these dreary, poor surroundings its effect is very arrogant, like that of a giant of old descent who struggles for survival.

While I am busy with my collections a humble-bee buzzes noisily round me and a spider darts away frightened, being disturbed in its chase by my intrusion.

About the 20th several lakelets (Figs. 2, 3) are free from ice and spring has come to Danmarks Havn also. The small wading-birds are now nesting and in the lakes one encounters Long-taileds Ducks, Eiderfowl, Red-throated Divers and Brent Geese.

Although it may be said that *Saxifraga oppositifolia* is now in flower nearly everywhere, it is evident that it is a little behindhand in places where it is exposed to the north. *Saxifraga flagellaris* is

Fig. 3. *Polygonum viviparum, Eriophorum Scheuchzeri, Stellaria longipes, Alopecurus alpinus, Saxifraga cernua* and *Salix arctica* on the margin of a lakelet near Danmarks Havn.

also in flower on the 20th, and *Cerastium alpinum*. *Pedicularis hirsuta* peeps forth with its shoot-tops, woolly with white hairs, and appears to be somewhat behindhand here around Danmarks Havn, for already on the 22nd a flowering individual was gathered on Lille Koldewey, although it was not yet in flower on the main land. It was one of the few species, whose first flowering-period occurred later in the year 1908 than in the year before.

It appears as if spring comes earlier in the Island of Maroussia than around Danmarks Havn, at any rate, there are many circumstances which seem to show this; for instance, the *Melandrium triflorum* brought home, was gathered there in flower earlier than I saw the plant in flower at Danmarks Havn, although it may have been an accident that a single species should be found in flower there before it flowered in other places.

Not until the 20th did Vester Elven force its way through its upper course; before this there had only been a local draining of the melting snow of Basiskæret. To the north of the bog large masses of snow are lying on the southern slopes of the mountains; it is from here that the clayey, gravelly flat towards the stream is irrigated, and already some days ago *Ranunculus sulphureus* was found flowering here in the more elevated parts of the gravelly flat, while the more low-lying parts of it are almost exclusively covered with *Alopecurus alpinus;* but as yet the latter shows no sign of life here, while *Eriophorum polystachyum* has reached its flowering stage.

We have now advanced as far as "midsummer," which in these parts is in reality the beginning of the summer. The transition in 1907 was indicated by the first rain of the year. On June 24 5.0 mm. of rainfall were measured; even if this was not a very large quantity it was sufficient to make traffic out of doors irksome. The rain began at noon and lasted all the afternoon.

In the course of the following eight days the floral display had reached its maximum. Probably about half of the flowering species are out now, thus all the *Drabas,* several *Saxifragas* and the most prominent of the *Ranunculi;* these species are the character-plants of the country which give the stamp to the landscape by the great abundance of their individuals. In the bog, for instance, *Ranunculus sulphureus* is now in full bloom and reminds one not a little of the *marsh-marigold* on a spring day at home when, with its yellow patches, it livens up surroundings which have hardly yet become green.

It is natural that moisture should be of the greatest importance to this, the culminating period of the vegetation. Referring to the measured amount of precipitation we see that June is relatively

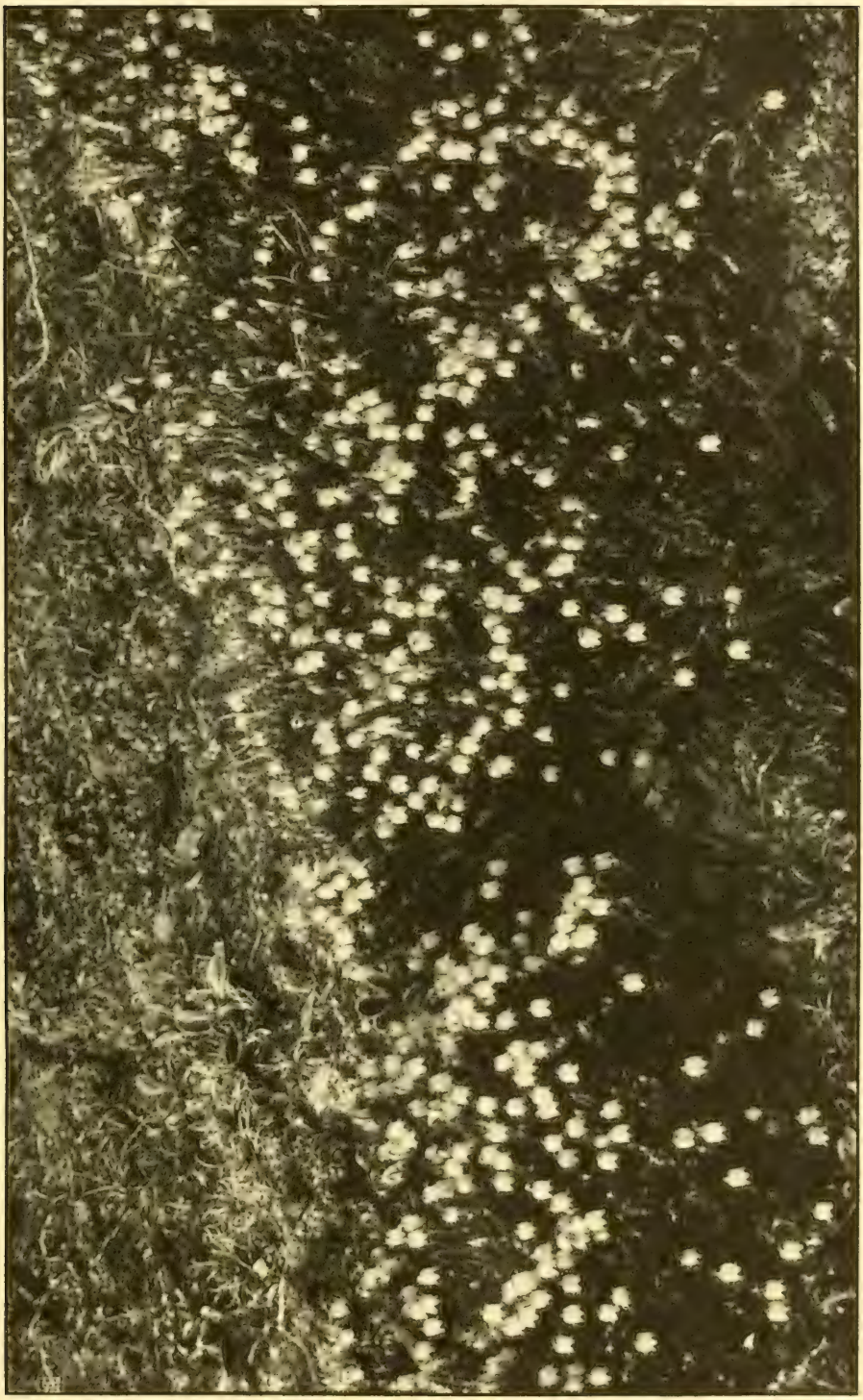


Fig. 4. *Cassiope tetragona* association in Germania Land.

conspicuous with 9.1 mm. spread over eight days. Until the 10th it appeared as snow, and not till the 24th as rain; but besides this measured moisture another factor is utilised-in addition to the most important of all which is, of course, moisture due to the melting process — viz. the fog; the causal connection of this is less conspicuous but certainly of no less importance both directly and indirectly. At the end of the month we often had south-easterly winds and a dense fog from the sea crept over the land, where it soaked everything, and this sometimes happened several days running. For lichens and mosses this form of moisture is undoubtedly of the greatest importance, but the whole vegetation profits by direct absorption; to this should be added its indirect significance to evaporation which is modified to a high degree when the fog lies densely upon the surface of the earth.

Under such circumstances the temperature of the ground and the water, provided currents do not supervene, is the same at night as by day and coincides very nearly with that of the air. This is proved by the following interesting measurements.

After an almost constant temperature, on the 24th of June 1907 ($+3.4°$, $+3.7°$, $+3.2°$ at 8 a. m., 1 p. m. and 9 p. m. respectively) I measured the temperature at night at 1 a. m. in a wet moss-tuft, again in a small stream and still again in a damp *Silene*-tuft and obtained everywhere $+3.4°$; the air was then $+2.9°$.

In the main channel of Vester Elven, where the current is rather strong, the temperature, on the other hand, was only $+1.8°$. The water on its way from the place of melting is not under the influence of the rays of the midnight sun when there is a dense cloud-covering as was the case here. In the evening of the 24th, at 9 o'clock, the wind was N. fast C. and the cloud-covering was 10^{1-2} ni.[1]

As the temperature, also, is of the greatest importance to the plant-life, not only must the supply of heat be able to be relied upon, but also it is necessary to economise that which has already been obtained; the point is to have as slight a loss of heat as possible. And here the cloud-covering also plays a great part in the condition of the plant-life.

We have above an example of the influence of the nimbus-clouds directly to impart moisture, and indirectly to retain the heat by moderating the evaporation. A dense covering of stratus-clouds also serves the latter purpose; but they are far more favourable to the vegetation when the conveyance of heat is concerned. While the fog was always coincident with low temperature, there might very well be conveyed to the ground a considerable amount of heat in

[1] Here and everywhere the figures indicate the amount of the cloud-covering, and ni., str. and fr.-str. stand for nimbus, stratus and fratus-stratus respectively.

spite of a dense layer of stratus, and under conditions when the temperature of the air was low.

Some of the measurements prove this. On June 28 we had: —

	8 a. m.	Temp.	+ 0.7°	Force of wind	2.3	Cloud-covering 10^1 str fr-str.
	2 p. m.	—	+ 1.1°	—	2.2	— 10^2 ni.
	9 p. m.	—	+ 3.5°	—	2.1	— 10^{1-2} str.
and on the 29th	8 a. m.	—	+ 2.6°	—	C	— 9^{0-1} str.

Although the sun had not been out during the night yet in the morning of the 29th at 9.45 the temperature in the main channel of Vester Elven was + 7.2° and in the soil under irrigation + 13.0°, and in the air + 2.8°.

This phenomenon I can only explain by the fact that the cloud-covering had not absorbed all the rays of the sun so that in spite of the dense layer of clouds there had been no slight supply of heat simultaneously with considerable modification of evaporation.

Fogs also continued during the month of July, in which the precipitation is so very inconsiderable. But during this month southerly-easterly winds are not always coincident with fogs.

The precipitation was measured in four days, all told. The heaviest rainfall occurred on the 9th and was measured as 1.1 mm. Moreover it rained a little on the 12th, 13th and 14th. The maximum of the last 24 hours was + 8.8°, up to that time the highest temperature of the year; the following day the fog hung again over sea and land, and the temperature was low.

Not till the 22nd does the fog rise and for the remainder of the month the weather is clear, the wind principally in the north-west.

On July 4 the summer is so far advanced that the Snow Bunting has young ones; the gnats begin to appear and around Danmarks Havn *Saxifraga oppositifolia* is fast approaching the end of its flowering-period. But at Cape Bismarck a lake is found where the ice is still lying; a narrow strip of water along the shore is the only visible sign of the spring not having passed over it without leaving its traces.

On July 5 the ice round the ship was so crumbly that the passage was unsafe even for the dogs; and on the day following the ship became free. Some little time, however, elapsed before we really got some heat, and the maximum of the year, + 12.3°, is not reached till the 17th; but then, on the other hand, the minimum is as high as — 2.0° and of the 30 days with a positive mean temperature 15 are even quite frost-free.

The hottest day of the year fell on July 31 with the highest recorded temperature; the sum of the three readings of this day

(+ 5.6, + 11.1 and + 3.0, at 8, 2 and 9 o'clock respectively) is 19.7°. At 1 p. m. the black-bulb thermometer recorded + 42.0°.

The gnats occur to a degree that is most tiresome, though they are not nearly as numerous as in the corresponding swampy districts on the west coast.

In spite of the heat the summer must be said to have finished by the end of this month; all plant-life had been long before on the descent and even the late-flowering species have reached their last stage of development—fruit-setting. The high temperature during the day does not suffice to call forth and continue the development of those species and individuals which perhaps appear first at this time from beneath the melting snowdrifts. From the beginning of August we have to reckon with a fairly distinct day-period; already in the night between August the 4th and the 6th the thermometer went down to — 2.0°. Not till the 23rd did we get a negative day-temperature, but three days later we had the first 24 hours of continuous frost.

There is plenty of precipitation during the month; 16.1 mm. of which half fell on the 12th.

The melting of the snow reached its maximum, with the largest bulk of water in Vester Elven, on August 3rd.

With the setting-in of frost the cycle of the vegetation is virtually at an end for this year. Only here and there we find — in shelter and under the influence of the sun's heat in the middle of the day — a few *Ranunculi*, *Saxifragæ* and other hardy plants in bloom; but I am under the firm impression that the period of growth was considerably longer in 1906. On the other hand in 1907 more snow seems to have melted than the year before. As far as can be judged more snow was lying on the mountains then than there is now lying at the same time of the year.

The appearance of the old snowdrifts also indicates this. The more the snow melts away the darker become the surface-layers which mark the pauses between the different snowfalls of unequal thickness which, in the course of the winter, build up the snowdrift (Fig. 5). And that layer will be darkest which is the last to be melted during a summer period, especially if it lies deeper than the melting-level of one or more previous years. For every time the storms, in the course of the winter, have brought the snow to rest in a drift, loose material is brought thither from the fields above. This material continues to cover the snow in layers and helps, very much, to hasten the melting because of its dark colour.

Such a stratification can be seen in profile at lakes and other places where the drifts are undercut by water so that the outer

edge appears with a vertical fracture after parts of the drift have tumbled down. At such places the latter, in its consistency, reminds one of a glacier, and the perennial snowdrifts fully justify the name of glacier, formed as they are like the land-ice by the snowfall of many years.

With September, autumn had entered upon a more austere stage than at the same time in the previous year. This applies in particular to the first third of the month; in 1906 we had then a rather high positive temperature while in 1907 we had a negative mean temperature already in the first week of the month, which was of great and fatal import to the vegetation, as it meant an abrupt termination to the life of those individuals that were belated. On September 11 the maximum temperature was the same in 1906 and 1907, namely + 2.8°. Then followed the lower temperature which in 1907 brought the summer period to an end about a fortnight earlier than in 1906.

If the mean temperature of the whole month is considered exclusively, the difference between 1906 and 1907 is but small, as we have in 1906 — 3.3° against — 4.0° in 1907. This slight difference, which is owing to the higher temperature at the end of the month in 1907 might lead to the supposition that September 1907 must in the main have presented itself nearly as did the same month the year before; but facts show, all the same, considerable discrepancy which is clearly indicated by a comparison of the means for each week.

	1st week	2nd week	3rd week	4th week
1906	+ 2.57°	— 1.72°	— 5.81°	— 7.67°
and 1907	— 0.42°	— 3.52°	— 6.72°	— 3.67°

What is decisive here is naturally the earlier appearance of the frost rather than its severity.

In 1906 passage across the ice between the ship and the shore was established on September 20; while in 1907 the sheet of ice had already formed a bridge on September the 1st. However, some days later the traffic was broken off by storm and springtide, but yet lasting communication was established some ten days earlier than in the previous year.

Vester Elven also suspended its activity somewhat earlier than in 1906 when it supplied drinking water to the dwellers on land as late as September 18, while in 1907 the river-bed was dried up already on the 9th.

On September 27 we had our first snowstorm; at two in the afternoon the storm was in full swing although the wind greatly

increased in violence later on in the day with a more copious fall of snow. This, the first snowstorm, occurred exactly a month earlier than in 1906, but otherwise under similar conditions, starting from the north, whence the wind veered to NNW., attaining a velocity of about 20 metres per second. As sudden a rise of temperature as in 1906 did not take place, but yet the temperature rose to +0.2 in the course of the night.

The percentage of the moisture in the air was low on an average, often below 50; the lowest percentage of moisture recorded is 36 on October 3, 1907. Both in 1906 and 1907, autumn — or the time when the frost arrives — was accompanied by north-westerly winds which dried up the ground and thus created better conditions for the plants which, after having finished their development, were ready to meet the advance of winter. As regards the majority of the species seeds had been set abundantly. No doubt it also holds good for the buds which have been formed, that they are much more protected in a relatively dry condition than if they had been covered with ice before the snow-covering came. Evaporation and the desiccation resulting from it are further prevented by a protective sheath of old leaves (cf. List, pp. 23 and 27: *Lesquerella* and *Potentilla pulchella*).

As will be seen from the table, the mean temperature for October appears about equal for both years. The first part of the month was much colder in 1907 than in 1906; on the other hand the conditions were reversed as regards the latter part. Otherwise there is a distinct similarity between the two months in many cases; this applies, among other things, to the direction of the wind, which is principally westerly. Between the two points of the compass W. and N., both inclusive,

1906 shows 52 readings
and 1907 — 57 — ,

next comes calm with

1906 — 30 —
and 1907 — 24 —

E. is represented by two readings both in 1906 and 1907.

The different directions of the wind cause some differences in the humidity of the air; the air is usually dry with westerly wind; this applies, at any rate, to the summer-period. When the sea is open the percentage of moisture is somewhat increased during easterly wind or calm. In autumn, however, a low percentage of moisture often coincides with calm, while a higher percentage may occur with wind from the north-west.

An unusual mildness prevailed in December 1907 during the

days from the 17th to the 21st, when the temperature oscillated between — 0.6° and — 8.9°. The ground was covered with snow which lay slushy and heavy; without being acted upon, to any particular degree, by the wind, the snow was allowed to fill the low-lying places and depressions so that it made one uniform surface.

The last day of the year 1907 was until that time also the coldest day of the winter with a temperature of — 32.0°.

January 1908 was somewhat milder than in 1907. A violent snowstorm, in the middle of the month, blew the hills free from snow, and considerable quantities of gravel and pebbles were carried in the drift so that the snowdrifts were coloured dark thereby. Some snow fell again some days later during calm weather, so that an opportunity offered itself to measure the thickness of the layer of fresh snow which had fallen. It is very difficult to get a reliable computation of the precipitation which falls in the form of snow by the ordinary apparatus, especially when it is blowing. For that reason it may be of interest to give some figures which show the unreliability of the results, even under conditions of calm. On January 18, 7 cm. of fresh snow fell, which according to the rain-gauge measured 3.4 mm. On the day following 11 cm. fell, which according to the rain-gauge amounted to 2.6 mm. only. It is often quite impossible to decide, during drifting, whether any fresh snow is falling or not.

As I stayed at the station at Pustervig from January 29 to March 6, 1908, I had an opportunity of comparing the atmospheric conditions which prevail there during a winter-month with the conditions at Danmarks Havn. As was to be expected they agreed fairly well as regards temperature, pressure and amount of moisture. At Pustervig also, the snow-covering was inconsiderable on the more level ground. The distance from Danmarks Havn is about 75 km., the indentation of coast-line is the deepest in Germania Land. Unfortunately I had no opportunity of visiting the place at summer-time as the station there was vacated on June 1st.

I have calculated the mean temperature for a month of 29 days, from February 7th to March 6th. The result is — 28.07° at Danmarks Havn as against — 28.0 at Pustervig, where, however, there were many days far colder than any in the former place, where only one day, February 21 (— 37.7°), had a temperature below — 35.0° as against five such, and even colder, days at Pustervig.

The month of March had less precipitation than in 1907. On the 28th we had the last snowstorm of that winter; during the storm snow, to a depth of 25—30 cm., was blown away from

the level ground round the pathway from the house on the land to the thermometer-stand ("Die englische Hütte"), and after that the eastern side of Harefjeld stood out fairly bare. Immediately before the snowstorm we had peculiarly mild weather with easterly winds, which was probably due to a great deal of open water at sea.

A raven was seen at the end of the month, and seals also were seen on the ice as early as during this month.

On April 5 the Snow Bunting arrived. Otherwise the month was cold and dry as in 1907. The minimum temperature, — 33.7° fell on the 3rd, and the maximum, — 3.5°, on the 28th. Towards the end of the month it was milder than in 1907, and as was afterwards seen this mildness proved to be the beginning of a summer both earlier and warmer than that of the year before. The mean temperature of the month was — 19.2°, somewhat lower than in 1907, which was due to the severe cold in the beginning of the month. A comparison between the mean temperature of this and the following month showed also what was, on the whole, the greatest temperature-gap which occurred between any two successive months. A similar gap occurred between the mean temperatures for September and October. Here these numbers are compared

		for September and October	
1906	— 3.3	— 14.0	Dif. 10.7
1907	— 4.0	— 14.3	Dif. 10.3

and for the months

	April	May	
1907	— 19.0	— 7.9	Dif. 11.1
1908	— 19.2	— 6.1	Dif. 13.1

The weather during the first days of May formed an immediate continuation of that of April, but already on the 6th the temperature rose fairly considerably and after this intimation the temperature of the 7th ultimately reached the positive side: at 5 o'clock in the afternoon the thermometer stood at + 3.0°. So high a temperature was not reached in 1907 until June 1; also a positive temperature on the whole was not reached until 17 days later in 1907 than in 1908.

This early occurrence of a higher temperature was visibly indicated by the small pools due to melting snow, which formed about three weeks earlier than the year before, when such pools were not found until towards the end of the month. Already for a long time ago the mountain-sides facing east and south have been darkening considerably, and only the higher parts — seen from a distance — are

still white. The air is, on the whole, dry — also with easterly wind: a somewhat higher percentage of moisture is common with calm.

With these possibilities for the reawakening of plant-life, spring must be said to have commenced, and a fortnight later I also found decidedly new leaf-shoots upon a *Cerastium*-tuft which on May 21 stood under the snow with flowers from the preceding autumn which looked so fresh, that at first sight they could very well be supposed to have expanded recently.

On the 9th and 10th we had dense frosty fogs with falling temperature, down to — 15.4°. The following days were also rather cold with frequent fogs. But the snow was seen to disappear day by day as soon as the sun came out and exerted some power.

On the 20th snow fell and formed a thin layer; the following day was also densely cloudy, and there was a fine sprinkling of snow which melted immediately in places previously bare. Then it cleared up for a few days with westerly winds and a temperature of about — 5.0°, until on the 24th we again had fog and snow-squalls. On the 25th a positive temperature was again reached which continued for a longer time. It was cloudy from early morning and in the course of the forenoon snow began to fall so heavily that gradually a layer of it covered everything. But although the sun did not come out this snow melted rather quickly during the afternoon; small pools were formed only upon the bare primitive rocks; otherwise the soil quickly absorbed the moisture thus conveyed to it. At last on the 28th the sun shone in all its splendour from early morning, and as early as 9 a. m. we had a temperature of + 3.0°. The wind was then westerly; but soon afterwards it turned to the east and the temperature again went down to below zero. Later in the day the fog rolled over the land, and the sun's rays penetrated only slightly through it late in the afternoon. At this time of the year the gravel-fields are thawed to a depth of about 10 cm. Evidently only the warmth of the sun was wanting to call the plants forth. The appearance of a fly announced the reawakening of insect-life.

At night a large flight of birds occurred and in the evening I saw in Basiskæret Dunlin, Turnstone and Ringed Plover. Further towards the south Sea Gulls had been seen; Buffon's Skua, also, was seen the same night; last year the first one was shot on June 5, but, as mentioned above, I had then already seen two at Cape Marie Valdemar on April 23rd.

When I ascended the mountains on the 29th and surveyed the sea-ice it displayed several cracks, and it was said that a movement in the ice-fields had also been observed. In spite of an almost positive temperature during the last days of May practically no

progress could be traced as regards the vegetation. Only the lichens stood fresh, especially upon stones. But under the fresh snow which frequently covered everything, much was being prepared, hidden from sight.

The upper layer of the soil was thawed at that time wherever it had no snow-covering, and the clay in Basiskæret had already become so muddy that it was quite laborious to walk about on it. Larger pools were also met with at this time where the numerous wading-birds lived.

When, in the night of the 30th, I drove to Pustervig snow began, and as the wind grew stronger later in the night there was considerable snow-drift. The boggy tracts around Stormkap were mostly covered with snow and had a very winterly aspect in spite of the year being well advanced. In several places Snow Buntings were found which had evidently died of hunger, as the ground had been frozen where they should find their food. The snow was damp when it fell and in many places it froze and occurred as an icy covering upon the ground and upon the projecting parts of plants; this is not to be wondered at as the temperature was still low by night, and even went down to —9.3 during the last 24 hours of May.

The vegetation at this time was not further developed in Pustervig than at Danmarks Havn.

At the end of May everything was at a standstill, so to speak, and was far from having reached the development which the warm days on the 6th and 7th had at that time indicated; but a considerable amount of moisture had been conveyed to the ground, far more than was registered by the 5.0 mm. downfall; and owing to the fact of the ground being thawed earlier and containing more moisture, preparations were being made for a quick development of the spring flora, even if it began later than there had at first been reason to expect — as regards *Saxifraga oppositifolia* and a very few other species even later than in 1907.

The month of June 1908 began with clear weather and relatively cold nights. Not until the 8th did we have a positive temperature at all three readings. This was reached last year as early as May 30; and occurred again on five additional days in June before the 8th; which was probably the reason why *Saxifraga* was then in flower as early as the 4th, while this year that stage of development was not reached until the 7th.

Then came again some days with fogs from the east and south and a low temperature so that the melting of the snow progressed slowly. Not until the 12th was there enough running water in

Basiskæret for us to be able to obtain drinking water there — several days later than last year. A small lake near the station was almost free from ice and was visited by Long-tailed Ducks and loons. The next day the wind was again north-west and the sun was allowed to shed its rich warmth without hindrance over all the country and call forth the humble-bee simultaneously with the first flowering *Salix*. And now the awakening process proceeded without intermission, so that every day new species appeared: *Draba hirta*, *Draba alpina*, *Eriophorum polystachyum*, *Ranunculus sulphureus*, etc. The 18th was the first real summer day, on which the maximum reached + 8.2°. Vester Elven "forced," i. e. made its way through its upper course, and as this phenomenon occurred two days earlier than was the case last year, so also everything appeared at this time to be further developed than the year before; this also applies to the first-flowering of the above-mentioned species which occurred from one to four days earlier than in 1907. On the same day *Ranunculus glacialis* and *Oxyria digyna* were seen in flower. The mean temperature of June was 0.2° lower than that of last year. The mean for five days was as follows: — — 2.3°, — 0.03, — 0.82, + 2.38, + 3.35 and + 5.37. Consequently, the warmth did not set in until the middle of the month. We had a positive mean on the 8th, 9th, and 15th. After that the mean temperatures were exclusively positive, although the minimum did not become positive until the 18th. The latter half of the month was decidedly more favourable for the vegetation than was the case last year, and many species were well in progress as regards fruit-setting before the end of the month.

The absolutely highest temperature was + 11.6° in the afternoon of the 28th. Last year the maximum, + 7.3, was reached on the 20th. There is thus a considerable difference as regards the warmth of the same two months in 1907 and 1908 respectively, and the difference is in the latter half of the month, which this year had been freer from fogs than was the case last year.

The ice between the ship and the land was traversed for the last time on June 30th; in 1907 it could be traversed until July 6th.

The month of July began by being warm. The wind continued from the west and the air was clear and dry. From June 24 to July 12 there was no frost, consequently, there were in June 9 days, as against 6 last year, and in July 12 days without frost. In 1907, there were 18 days in the whole of July without frost. From the 13th the wind often veered to the south and east, which caused fogs and low temperature, and thus the days continued till our departure from Danmarks Havn on the 21st.

In continuation of the foregoing remarks regarding the climate and the phenology I shall now give some observations concerning the insolation. These measurements were effected with a black-bulb thermometer in vacuum and an ordinary swinging thermometer, which were placed at a height of $2^1/_2$ metres on the southern gable of the villa against a background of black roofing paper. The temperature of the air is given according to the thermometer-case.

March 3, 1907. Sun's altitude at midday 6°17′

Time.....	1 p. m.	1.15 p. m.
Air.....	— 29.6	— 29.4
Black bulb	— 4.6	— 9.0
Blank bulb	— 21.0	— 20.0

March 10, 1907. Sun's altitude 9°

Time.....	11.30 a. m.	12.30 p. m.
Air.....	— 29.5	— 28.8
Black bulb	0.0	+ 0.8
Blank bulb	— 23.0	— 20.2

March 11, 1907.

Time.....	11.30 a. m.	12 midday	12.35 p. m.	1 p. m.	1.30 p. m.
Air.....	— 26.0	— 25.8	— 25.6	— 26.5	— 25.1
Black bulb	+ 0.9	— 0.2	+ 0.5	+ 0.5	— 1.0
Blank bulb	— 16.7	— 18.8	— 16.9	— 14.9	— 17.8

March 12, 1908.

Time.....	11 a. m.	12 midday	12.50 p. m.
Air.....	— 29.0	— 27.0	— 26.2
Black bulb	+ 1.0	+ 3.8	+ 4.5
Difference.	30.0	30.8	30.7

March 13, 1907.

Time.....	10 a. m.	10.30 a. m.	11 a. m.	11.30 a. m.	12 midday
Air.....	— 19.6	— 18.6	— 18.5	— 17.7	— 19.5
Black bulb	+ 5.4	+ 8.0	+ 10.0	+ 10.8	— 5.2
Blank bulb	— 12.0	— 7.0	— 6.2	— 2.2	— 10.2

During the last observation the sun was somewhat clouded.

March 15, 1907. Sun's altitude 11°

Time.....	10 a. m.	10.30 a. m.	11. a. m.	11.30 a. m.	12 midday	12.30 p. m.	1 p. m.
Air.....	— 21.0	— 20.9	— 20.4	— 19.0	— 21.0	— 20.5	— 21.2
Black bulb	+ 2.6	+ 1.4	+ 4.5	+ 9.5	+ 9.2	+ 8.6	+ 8.0
Blank bulb	— 11.8	— 15.6	— 10.0	— 4.9	0.0	— 0.3	— 1.8

March 15, 1908.

Time	12.5 p. m.	12.50 p. m.
Air	— 22.6	— 23.2
Black bulb	+ 5.7	+ 4.5
Difference	28.3	27.7

March 21, 1908. Sun's altitude 13°19′

Time	11 a.m.	11.30 a.m.	12 mid.	12.35 p.m.	1.10 p.m.	1.30 p.m.
Air	— 27.2	— 25.6	— 26.5	— 28.5	— 26.5	— 27.0
Black bulb	+ 5.0	+ 7.0	+ 5.2	+ 6.1	+ 6.6	+ 3.3
Difference	32.2	32.6	31.7	34.6	33.1	30.3

March 26, 1908.

Time 1 p. m. Air — 11.3 Black bulb + 15.6

March 31, 1907. Sun's altitude 17°14′

Time	11 a. m.	11.30 a. m.	12.30 p. m.
Air	— 19.2	— 19.5	— 19.4
Black bulb	+ 15.0	+ 18.0	+ 14.4
Blank bulb	— 5.0	— 3.8	— 3.7

March 31, 1908.

Time	11 a. m.	2 p. m.
Air	— 21.5	— 18.8
Black bulb	+ 7.6	+ 12.0
Difference.	29.1	30.8

April 2, 1908.

Time	12 midday	12.50 p. m.	2 p. m.
Air	— 27.2	— 26.4	— 23.2
Black bulb	+ 9.3	+ 6.6	+ 11.0
Difference.	36.5	33.0	34.0

These observations, which were distributed over 11 days during the years 1907 and 1908, show what is especially characteristic of the radiation, viz. its quick rise in the spring. On March 10, 1907, the black-bulb thermometer, for the first time, reached a positive temperature, and differed from the temperature of the air by 29.6°. Three days afterwards the insolation was + 10.8°; the difference being then 28.5°, the temperature of the air having simultaneously risen 11.1°. The reading on the 15th at 11.30 a. m. gave the same difference. But on the 31st the black-bulb thermometer registered + 18.0° with about the same temperature of the air as on the 15th, and the difference then reached 37.5°; this was the maximum for the year 1907.

In 1908 observations were made for the first time on March 12, and even then the black-bulb thermometer stood 30° higher than the station-thermometer; 3 days earlier, therefore, than in the previous year, when this result was not attained till March 15. But the greatest difference is a little lower than in 1907, and occurs a little later — April 2nd.

For some of my measurements of temperature in the field, I also employed the black-bulb thermometer and, at the same time, thermometers with a blank bulb and with a coloured, brown bulb. For the measurement of the temperature of the air the swinging thermometer was then employed.

May 17, 1907, at 3 p. m.
Air — 7.0°
Black bulb + 13.0°
Blank bulb + 6.8° } lying on a level gravel-field.

May 20. Air — 2.0°
At 1.35 p. m. Black bulb upon the mountain, in a tuft of *Luzula* ..... + 29.6°
At 1.45 p. m. Black bulb in wet clayey soil..... + 26.6°
At 1.55 p. m. Black bulb upon the snow..... + 34.0°

On July 3, at 5 p. m. Air + 8.6°, the black-bulb thermometer registered on an irrigated gravel-field facing the south ..... + 24.7°
(with running water upon the ground ..... + 14.8°)
on a tuft of *Draba*..... + 29.7°
on light-coloured clayey soil ..... + 31.2°

July 4, at 11 a. m. Air + 8.3
Black bulb in a tuft of *Potentilla* on the mountain + 35.8
(The earth at a depth of 4 cm. showed ..... + 13.8°
and the water in a small tarn with a snowdrift on its bank showed..... + 13.0)

July 21, at 7.45 p. m. Air + 1.5°
Black bulb + 17·0
Brown bulb + 10.6
Blank bulb + 10.0 } all three thermometers lying insolated on flowering *Cassiope*.

The day had begun with fog, but this lifted about 2 o'clock, when the sun shone slightly.

July 31, at 1 p. m. Air + 10.3
Black bulb + 42.0
Brown bulb + 34.0

During the observations the wind changed and became easterly, whereupon all the thermometers commenced to fall. Both with this observation and with the following observations made with the black-bulb thermometer in 1907, the thermometers were placed on the gable of a house, in the same way as during the observations made in the month of March.

On August 7, 1907, at 2 p. m.; temp. + 1.7; amount of cloud 10°

Time	2.30	2.45	3	4	5
Air	+ 4.5	+ 4.3	+ 4.1	+ 4.8	+ 3.3
Black bulb.	12.0	11.5	11.5	24.8	10.7
Brown bulb	9.0	9.6	8.8	13.8	7.5
Blank bulb.	8.3	8.4	8.0	10.8	5.9

At four o'clock the sun was out, but not in great strength.
At five o'clock there was only very slight insolation.
After a night with a positive temperature the following were the measurements on August 8th.

Time	11.30 a. m.	11.45 a. m.
Air	+ 8.4	
Black bulb	+ 30.5	38.5
Brown bulb	+ 24.0	28.0
Blank bulb	+ 18.0	23.5

Even as late as October 1, when the air was — 12.0°, the black bulb showed + 12.0° at midday. The sun's altitude was almost the same as on March 15th.

October 7, at 12.45 p. m. Air — 4.4
Black bulb thermometer + 13,0

But on October 15 the importance of the insolation was nearly at an end, as is shown by the following figures: —

October 15, at 2 p. m.	Air — 19.5	Black bulb shows	— 9.7
— 16, - 10 a. m.	- — 14.6	—	— 9.6
— 17, - 2 p. m.	- — 16.1	—	— 10.5
— 18, - 12 a. m.	- — 15.3	—	— 3.0
— 18, - 2 p. m.	- — 15.3	—	— 11.3
— 19, - 12 a. m.	- — 14.4	—	— 1.4
— 19, - 2 p. m.	- — 15.8	—	— 10.5

The difference between insolation and non-insolation was practically *nil*. Just at midday, the effect was somewhat noticeable if the thermometer, as in this case, was placed high up, where it could catch the rays of the low-lying sun—surreptiously as it were. On level ground the effect was almost unnoticeable.

When no mention is made of the amount of cloud, the observations have been made beneath a cloudless sky. The amount of cloud 10 with the exponent 0 signifies that the sky was entirely covered with a thin layer of cloud.

The observations of the insolation which especially concern the midday radiation differ most astonishingly from the temperature of the air, so long as this is still low — therefore, early in the year, although the sun's altitude is then also low. A comparison of two measurements shows that the difference was less on July 31 than on March 31 1907, and that the rise in the temperature of the insolation does not keep pace with the rise in the temperature of the air, in spite of the sum-total of the radiation lying naturally nearer its maximum in July than in March.

	Air	Black-bulb thermometer	Difference
March 31, at 11.30 a. m.	— 19.5	+ 18.0	37.5
July 31, at 1.0 p. m.	+ 10.3	+ 42.0	31.7
	Difference 29.8	Difference 24.0	

The sun's altitude, respectively: 17°14′ and 31°36′. The sun's culmination at Danmarks Havn 36°41′.

Notwithstanding the problematic value of these figures to indicate the warmth which is conveyed to the vegetation by the radiation, I have employed them, well knowing that they do not afford absolute data for arriving at a decision. We have no means of establishing such data, as we do not possess any registration-apparatus which can indicate the course of the radiation through any complete period — twenty-four hours a week, or longer — which would perhaps illustrate the conditions rather more reliably, and especially might be able to give us a better idea of the sum-total of the radiation.

We know from experience that there is a supply of warmth, but its magnitude depends on many factors; the conditions of the country and the nature of the ground play their part, as the height of the sun in the sky at different times also plays its part.

In addition to the measurements which have already been given of the temperature at the surface of the ground, amongst plants, and in pools, lakes and rivers, with special reference to its relation

to the cloud-covering and its more or less complete independence of direct sunlight, I have made, at different times during the twenty four hours, and at shorter or longer intervals, many other measurements which elucidiate the warmth-conditions which usually prevail.

July 1, 1907	8 a. m.	2 p. m.	9 p. m.	Calm, with a fog in the morning, and amount of cloud 10[1] during the whole day.
Air . . .	+ 1.7	+ 2.0	+ 0.5	

At 12 midnight. Air + 2.8; Vester Elven + 4,2.

July 5, at 2 p. m. Air + 5.4, clear.

The water in Øster Elven	+ 11.2
Irrigated moss and *Salix* at a depth of 5 cm.	+ 11.2
Damp tuft of *Dryas* - — - 6 —	+ 10.4
— — - — - — - 12 —	+ 8.8
Stagnant water	+ 12.5
Dry, rather compact clay	+ 18.4
Dry, pulverized clay	+ 20.2

July 7	8 a. m.	2 p. m.	9 p. m.	In the morning amount of cloud 10[1], at midday the sun shone.
Air . .	+ 5.1	+ 4.8	+ 4.5	

	9.45 a. m.	6 p. m.
Main channel of Vester Elven (strong current) . . .	+ 8.5	+ 11.2
Stagnant water in a hole.	+ 5.0	
Running water at the side of the hole	+ 10.5	+ 13.2
Moist soil at a depth of 3 cm.	+ 11.0	
Soil less moist, but grown over	+ 12.8	
Wet clay in a depression	+ 11.5	
Dry clay	+ 14.0	+ 21.5
A dry tuft of *Dryas* between the withered leaves .	+ 13.5	+ 22.0
A dry tuft of *Dryas* at a depth of 6 cm.	+ 10.2	

Notwithstanding the sunshine in the afternoon the maximum of the day was only + 7.4, on account of a south-easterly wind.

July 10	8 a. m.	2 p. m.	9 p. m.	South-easterly wind of inferior strength.
Air . .	+ 3.4	+ 3.5	+ 0.7	

	12 midday	3 p. m.	6 p. m.
Blank bulb on the ground.	+ 22.0		
On a declivity with *Taraxacum, Draba hirta, Saxifraga rivularis, Ranunculus pygmæus,* and others at a depth of 5 cm.	+ 12.6		
Loose gravel at the surface	+ 16.2		
The water in a small lake with a barren, stony bottom		+ 12.2	

	12 midday	3 p. m.	6 p. m.
Moist ground with *Cassiope*, *Dryas* and moss at a depth of 8 cm.		+ 8.5	
Dry ground with lichens and *Pedicularis*, at the surface		+ 10.0	
The main channel of Vester Elven			+ 9.0
Water and moss			+ 9.2

July 15	8 a. m.	2 p. m.	9 p. m.	foggy all day.
Air	— 0.1	+ 0.9	— 0.7	

	1 p. m.
Moist ground with *Salix* and *Cassiope*	+ 8.0
Dry tuft of *Dryas*	+ 9.1
Vester Elven	+ 8.6
A snow-bridge across the river	+ 0.2

Notwithstanding rain and fog and a dense covering of cloud during the four previous days, the ground as well as the water was considerably warmer than the air.

July 21	8 a. m.	2 p. m.	9 p. m.	foggy all day.
Air	+ 0.7	+ 5.5	— 1.2	

	10.15 a.m.	7.45 p.m.
Vester Elven	+ 6.9	+ 8.7
Wet ground	+ 7.5	
Dry ground	+ 10.0	
Dry sand		+ 13.6
Dry tuft of *Silene*		+ 11.0
Tuft of *Cassiope*		+ 7.6
Damp, luxuriant tuft of *Dryas*		+ 11.6
Submerged gravel-field		+ 9.2
The water on the field		+ 8.8
Luxuriant submerged bog-vegetation		+ 11.6
The water thereon		+ 9.2

July 24	8 a. m.	2 p. m.	9 p. m.	Clear the whole day with a south-easterly wind and a little foggy in the evening.
Air	+ 1.8	+ 3.5	+ 0.5	

	4 p.m.	8.45 p.m.	10.30 p.m.
Insolated, brown bulb in the plant-covering	+ 21.8		
The water in a small lake, to windward	+ 14.0		+ 7.0
— — —, to leeward	+ 15.5		
Juncus and *Eriophorum* at the height of water-level	+ 9.0		

	4 p.m.	8.45 p.m.	10.30 p.m
Damp moss with *Salix*, at the surface ...	+ 16.5		
— — — — , at a depth of 6 cm.	+ 8.6		
— — — — , at a depth of 12 -	+ 7.5		
Dry soil in a crevice in the rock	+ 12.9		
The water in a small lake with a barren, stony bottom		+ 10.5	
Damp rocky flat		+ 8.3	
Rocky flat, drier, with *Carex nardina* and *Salix*, in the shade		+ 6.0	
Tuft of *Carex*, in the sun		+ 9.0	

July 25	8 a. m.	2 p. m.	9 p. m.	Clear. Westerly wind, almost calm.
Air....	+ 6.1	+ 7.7	+ 5.1	

	7 p.m.
The water in the same lake which was measured at 4 p. m. on July 24	+ 11.2
Juncus and *Eriophorum* at the height of water level	+ 7.0
Damp moss with *Salix*, at the surface	+ 9.8
— — — — , at a depth of 6 cm.....	+ 8.2
— — — — , at a depth of 12 cm.....	+ 6.2
Dry soil in the stone-crevice	+ 12.4
Damp soil	+ 11.7

Although these measurements were taken 3 hours later than on the previous day I did not expect the temperature to be lower, as the temperature of the air was considerable higher. Nevertheless there was a fall throughout.

July 31	8 a. m.	2 p. m.	9 p. m.	Clear weather. The warmest day of the year.
Air....	+ 5.6	+ 11.1	+ 3.0	

	1 p.m.
Blank bulb on dry gravel ...	+ 16.8
Brown — - - — ...	+ 18.2
Wet moss and *Salix*	+ 8.0
Damp tuft of *Dryas*	+ 8.7
Stagnant water in a pool....	+ 13.0
Running water on field	+ 12.0
Main channel of Vester Elven	+ 10.6

August 13	1.30 p. m.	Dense covering of cloud during the whole day and considerable precipitation.
Air.....	+ 4.5	

In wet ground with moss, *Salix* and *Polygonum*, at a depth of 2 cm.	+ 5.2
In wet ground with moss, *Salix* and *Polygonum*, at a depth of 7 cm.	+ 5.5
In wet ground with moss, *Salix* and *Polygonum*, at a depth of 14 cm.	+ 5.6
Gravel-field, at the surface	+ 4.7
— , at a depth of 6 cm.	+ 5.3

The gravel cools more quickly on the surface, and responds more quickly to the temperature of the air than does ground of more solid consistency.

June 9, 1908	4.30 p.m.
In a pool, at the surface	+ 10.0
— — , at a depth of 5 cm.	+ 9.0
In moss down towards the frozen ground at a depth of 4 cm.	+ 4.5
In dry moss and grass	+ 7.5
Blank bulb lying upon moss	+ 14.9
Brown — — — —	+ 18.4
Air	+ 2.0

June 14	8 a. m.	2 p. m.	9 p. m.	Sunshine.
Air	— 1.5	0.0	+ 0.3	

	10.50 a.m.
Wet ground with *Draba alpina*, c. fl., at a depth of 4 cm.	+ 10.0
Under a tuft of flowering *Saxifraga*	+ 8.0
The ground at the side of this, at the surface	+ 10.5
Slowly running water	+ 9.3

June 20	8 a. m.	2 p. m.	9 p. m.
Air	— 0.1	+ 3.6	+ 1.0

	3.35 p.m.
The water in Øster Elven	+ 3.0
Light-coloured, dry clay, at the surface	+ 17.5
— — — , at a depth of 7 cm.	+ 14.0
Light-coloured, dry clay at a depth of 14 cm.	+ 11.0
Blank bulb on light-coloured ground	+ 17.5
Brown bulb - — —	+ 20.6

Immediately afterwards the two thermometers showed respectively, on a darker background + 23.2° and + 27.0°.

The first cover of snow in the autumn of 1907 was formed during the snowstorm on September 27, after a mean temperature of 4.0° for the five previous days. The lowest temperature to which the vegetation until then had been exposed at Danmarks Havn was — 11.6. Some days later I made measurements of the temperature in the snow.

Date	Air	The surface of the snow	at a depth of 25 cm.	at a depth of 50 cm.	at a depth of 1 metre
Sept. 30	— 10.5	— 12.3°			— 5.8°
Oct. 1	— 12.1	— 14.8	— 9.6		— 8.0
— 15	— 19.5	— 24.2	— 13.0	— 12.0	— 11.0
— 16	— 14.6	— 20.8	— 18.5		

As is shown by the above, the temperature in the snow ranges downwards. The low temperature on October 15 was noticeable, even the day after, at a depth of 25 cm., while the temperature of the surface rose again with the rise of the temperature of the air, without, however, following the latter entirely; in fact, it actually presents the greatest difference from the air-temperature which I have ever measured, namely 6.2°; and here there was no question of a Foehn, but of a steady rise during the night until the moment of observation at 10 a. m. on October 16.

North of the station there was a large stretch of bog which, on account of its superficial conditions, had been employed as a triangulation-base from which it got the name of "Basiskæret" (the Basis-bog). Towards the north it was bounded by some low "roches moutonnées" at the foot of which, in the autumn, considerable snowdrifts were deposited. One of these was utilized for the following measurements: —

Date	Air	Mean temperature of the month	Surface	at a depth of 35 cm.	at a depth of 50 cm.	at a depth of 70 cm.	at a depth of 1 metre	at a depth of 1.60 metre	at a depth of 2 metres	at a depth of 2.50 metres	Remarks
1907											Measured by
Feb. 23	— 27.8	— 25.9	— 28.5	„	„	— 22.0	— 20.0	„	— 16.5	„	digging and
April 7	— 22.8	— 19.0	— 24.0	„	— 21.5	„	— 20.8	— 18.4	„	— 17.5	by boring the
May 7	— 14.5	— 7.9	— 17.5	„	„	„	— 15.0	— 16.2	— 15.5	— 15.0	thermometer
1908											into the
March 23	— 21.5	— 20.9	— 22.6	— 27.0	„	— 23.5	— 20.5	„	„	„	snow-wall.

As the table shows, the first of these measurements took place on February 23, 1907.

First of all, it was of importance to find a drift which had been lying somewhat undisturbed since the autumn, and which had merely been increased, without, at other times, with changes of the wind, having yielded any of the snow at one time deposited; as in such a case, a lower temperature would have availed itself of the opportunity to penetrate to a greater depth than, later in the winter, and in accordance with the thickness of the layer of snow, it might be expected to be found. Therefore the winter of 1906—1907 was more suitable for these measurements than the following winter when less snow fell, and no great snowdrifts lay unaffected by such erratic snowstorms, which might at times sweep away layers one metre in thickness, which layers would be replaced only when a storm from the direction of the prevalent wind (NW.) brought new layers upon the ordinary deposits to leeward. For the measurements, this lack of a constant layer of snow causes the results to be arbitrary, and makes it impossible to establish absolute values for the range of the temperature in the snow.

Even at a depth of 2 metres, I did not reach the rock beneath the snow; but this was as hard as ice, and of a consistency that only allowed of a very lengthened process of melting. As a rule, a vegetation which is covered by such an enormous layer will see daylight only so late in the year that it will never, in any case, be able to reach the flowering stage, and will not even be able, every year, to awake to life.

The figures show that the temperature is considerably higher downwards in the snow. Still, the mean temperature for the month stands rather high in the layer of snow, at a depth of about 30 cm., I think.

Twenty-four hours later, in the same hole, the snow-walls of which had been exposed to the temperature of the air, the following measurement was taken at a depth of 2 metres: — 22.5. The surface, like the air, being — 32.0.

Again, on April 7, I took measurements in the same place. But the layer of snow had increased by about 45 cm. in thickness. At this depth a hard crust was then lying, which indicated the surface of the snow on February 23; as this was now well hidden beneath the new cover of snow, it also showed a rise in temperature (from — 28.5 to — 21.5) owing to the fact that now the radiation of heat from below was prevented.

The same circumstance was noticed at a depth of 1.60 metre, which almost corresponds with the depth of 1 metre on February 23 (— 18.4 against —20.0). Here also a hard crust was found, which, earlier in the winter, had been the surface of the snow.

The latter depth corresponds with the former depth of 2 metres; here the temperature is shown to have fallen, viz. from — 16.5 to — 17.5. Here the new deposit has been unable to prevent the low temperature already existing from continuing its range downwards.

The mean temperature for this month, — 19.0, therefore lay at a depth of from 1 metre to 1.60 metre, perhaps at about 1.30 metre, or almost 1 metre lower than the temperature of February, and there is no probability of the low temperature descending lower at this juncture. The sun already stands high in the heavens, and the temperature is rising on account of the advanced time of the year.

The observations on May 7 cannot be considered as comparable with the earlier ones, as the old hole in the snow was now only half filled, and had perhaps stood open for a long time, so that the walls of the hole had been exposed to the direct influence of the air. In addition, the loose snow in the hole was far more porous than the old snow, which was now very hard everywhere, and had to be hacked up like ice.

The mean temperature for the month of March 1908, taken on the 23rd, lay at a depth of 1 metre, which corresponds well with expectations from the measurements in February and April 1907.

It is, of course, generally admitted that the snow-covering is an external factor of great importance as regards plant-life in the Arctic regions, and then, certainly, the snow is most frequently thought of as the sheltering cover which protects the vegetation against the severe cold of winter, and thereby renders possible the existence of more sensitive species. And, consequently, when a considerable layer of snow, even in the autumn, covers the ground and is allowed to remain, then the plants which pass the winter under this are not exposed fully and entirely to the same temperature that the snowless vegetation has to endure during winter. But in those parts of Germania Land with which I became acquainted, I have noticed that the snow is a very capricious protector, which may fail without warning, and at any time leave its protégés in the lurch. Layers of snow, so very great as to be able to preserve for the ground and its vegetation the relatively high temperature from the autumn, do not occur in the neighbourhood of Dove Bay. Inwards in the bay, at Pustervig, I found on March 1, 1908, on a gravel-ground south of the creek, a branch of *Salix* with full-blown male flowers, lying freely exposed. Probably, after a summer which had terminated abruptly the year before, this branch had been hidden beneath the snow for the eventual, further development of the flowers in the succeeding year. But the snow shifts its position many times in the course of the winter, which may result in the plant, as in this case,

being exposed at the very coldest period. I had no opportunity to observe the fate with which these flowers met.

When the snow lies longer on large flat stretches of land than on a more rugged ground, it is due both to the fact that on the plain there is a thicker layer of snow and to the fact that the sun dissolves this more easily on a rise in the ground.

The thickest covering of snow which I have seen disappear so early in the year that the underlying vegetation could come forth was the 2-metre thick layer of snow between the thermometer-stand and the villa, which, in 1908, melted before the middle of July. But here, this deposit of the layer of snow was owing to the presence of the villa, so that the condition of the vegetation previously existing was changed by chance. The appearance of the vegetation does not enlighten us, therefore, with regard to what the aspect would have been if the place had been hidden every year under such a covering.

As already mentioned the snow lay somewhat more continuously in 1907 than in 1908. But there are always places where, in accordance with the nature of the ground, the snow must be heaped up in drifts, for instance in narrow fissures, and rock-crevices. Here it might be expected, then, that the snow would cover those species which, on account of their delicate nature, had not dared to venture forth in more exposed places; where, moreover, they would not find such a good substratum as such fissures, with their great possibility of humus-formation, might be able to offer.

When, now and again in the winter, I found such a fissure which, in consequence of its favourable exposure, might be supposed, during summer, to contain species which usually did not occur near that place on the rocky flat, I always visited it in the summer, provided it was possible to do so, and if it was early in the summer I regularly suffered the disappointment of finding it filled with ice, and otherwise, if the ice had managed to melt away, I found it, in most cases, quite barren; as it naturally must be, seeing that the ice, as a rule, does not have time to melt.

Many such well-protected localities lose their importance as regards the vegetation just by this, that, early in the summer, melted snow from higher lying places oozes into them during the day and saturates a part of the snow, which then, during the cold of the night, is transformed into a solid mass of ice, which thaws very slowly.

From a biological point of view the essential importance of the snow is that it prevents evaporation in winter and produces moisture in summer. When, as is the case, the conditions are such that the country receives almost all its precipitation in the winter, the

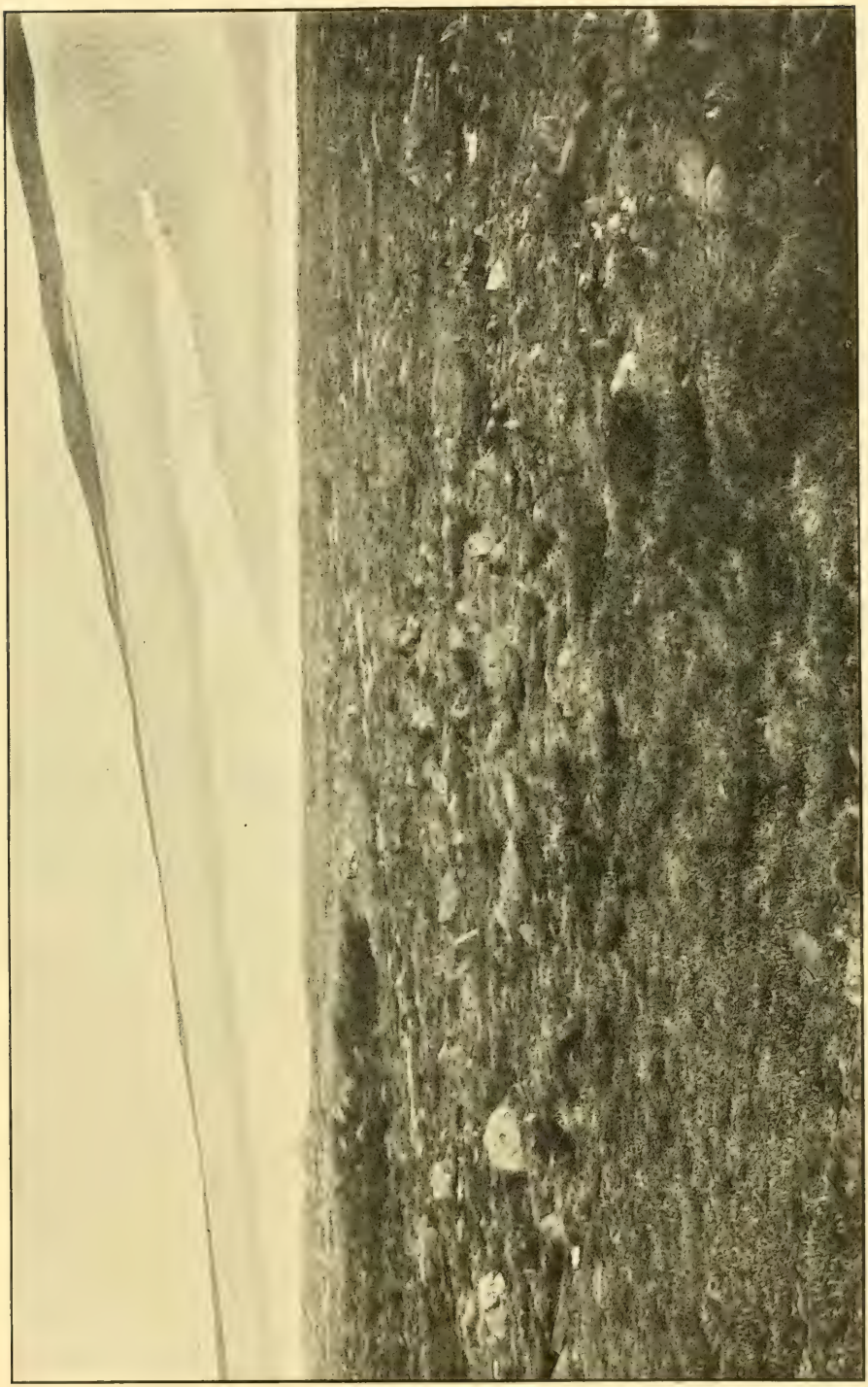


Fig. 5. *Eriophorum*-bog, to the east of Hulesøen, watered by a perennial snowdrift upon which the remains of the previous winter's snow is still seen (Aug. 5, 1907).

snow is a very convenient form for this, because it affords a possibility of regulating the moisture during the summer.

Compared with this, the importance of the snow as a protecting cover is very subordinate, because this cover is not constant, nor are there many species which rely on it, and with regard to which it may reasonably be supposed that they require a snow-covering for their existence in these regions.

The main result of my measurements really shows me only what was to be expected, that in the summer there may be a con-

Fig. 6. *Hippuris*-association in a lakelet near Danmarks Havn.

siderably higher temperature in the earth and the water, which is independent of a far lower temperature in the air. And a short period with a temperature below zero need by no means prove fatal to the parts of the plant above ground; but I do not know the temperature which causes the death of the protoplasm, nor whether the same low temperature always has the same effect; presumably the conditions during the thaw also play a rôle in this connection. Further it would be of interest to obtain measurements of the temperature of the living parts of plants during assimilation.

Even long before the snow-covering disappears, radiant heat is conveyed to the soil below it, as has been proved by measurements taken with a black bulb thermometer.

On April 27, 1908, between 1 and 2 p. m., the meteorologist of

the expedition, Dr. A. WEGENER made an experiment, regarding which he writes as follows in "Meddelelser om Grønland," XLII, p. 300: —

"C. Strahlung durch Schneeschichten hindurch. Um die in botanischer Beziehung wichtige Frage zu untersuchen, wie weit sich die Sonnenstrahlung durch Schneeschichten hindurch bemerkbar macht, wurde des Schwarzkugelthermometer und ein ungeschütztes Thermometer in Höhlungen in einer Schneewehe derart

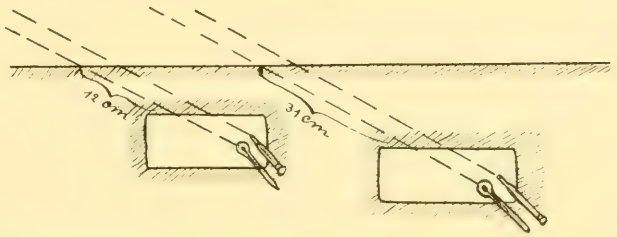


Fig. 7. Anbringung der Strahlungsthermometer unter dem Schnee.

angebracht, dass sie sich dort unabhängig von der aussen herrschenden Lufttemperatur einstellten. Die Länge des Weges, den die Sonnenstrahlen bei ihrem schrägen Einfallswinkel durch den Schnee hindurch zurückzulegen hatten, wurde dann unter Benutzung des Schattens ausgemessen. Die Anordnung des Versuchs ist in Fig. 7 dargestellt. Es ergab sich:

Zeit	Weglänge der Strahlen im Schnee	Unbeschütztes Thermometer	Schwarzkugel-Thermometer	Differenz
1P00	12 cm	— 9.2	—5.7	3.5
1 15	11 -	—10.4	—8.3	2.1
1 40	31 -	— 9.3	—9.4	—0.1
2 15	31 -	— 9.9	—9.9	0.0

Die hier benutzte Schneewehe war von derselben Festigkeit wie Nr. 1 in der Versuchreihe vom 24.—25. April, der Wassergehalt war also ungefähr: 1 cm Schnee = 4 mm Wasser. Die Ablesungen zeigen, dass bei ca. 12 cm Weglänge das Schwarzkugelthermometer noch merklich höher steht als das unbeschutzte Thermometer aber nicht mehr bei 31 cm. Eine Wirkung der Sonnenstrahlung dürfte demnach durch mehr als 20 cm Schnee (im schrägen Schnitt) nicht mehr vorhanden sein."

This heat causes considerable melting from below. This may be observed, e. g. on undulating ground, in places where the snow-covering is thin, viz. on the top of hills, and at the outer edge of the gently sloping snowdrifts where low, hollow spaces, several metres in extent, may be found beneath the snow-covering; and as a result the parts of the snowdrift thus hollowed are easily broken

when trodden upon. This is often found to be the case in localities with a continuous covering of plants, e. g. *Cassiope*. On the other hand, at the foot of steeper snowdrifts, these hollows are not often known to occur, the reason being that only at its outermost edge is the snow-covering thin enough to permit the radiation to penetrate; besides, at its foot, a steep snowdrift easily becomes ice, owing to the melting snow, and then forms a compact mass on the ground. At the foot of such a perennial snowdrift I found, late in the year, only a few moss-fragments and a crust of *Nostoc* with *Gloeocapsa magna* and *Phormidium autumnale*. The presence of the moss-fragments proved that the snow had not always been lying there; but in this place it was not possible to demonstrate which species approach nearest to such an ice-edge, and are the first to take possession of the ground. When such an enormous snowdrift melts, the result often is that the ground below it remains a barren slush of clayey mud, until it again becomes frost-bound.

III. The Vegetation. The Biology of the Flowers.

As the list by OSTENFELD & LUNDAGER shows, the country is very poor in species. Out of the small number 92, 14 species have been found at only one or at most two places, and a few were found as single individuals only.

In the above I have tried to show how inhospitable are the conditions offered by so important a factor as the climate, and in this I found a probable reason for the poverty of species. And yet I was sometimes disappointed because localities, which must be termed relatively good, nevertheless showed a still more decided poverty of species than did the exposed rocky flat.

The most important point is not that, on the whole, a favourable season of the year for the vegetation is wanting, but that the time when moisture and warmth are to hand is too short.

The climate determines the condition of the substratum. As the summer is so short — only two months, reckoning from midsummer towards the end of August — sufficient organic matter cannot be formed from plant tissues during that time. There is scarcely a single spot where real humus-formation can be demonstrated. Even in places where the conditions appear most favourable, as upon sheltered hill-slopes where fallen and decaying parts of plants are really deposited and are here and there allowed to remain in peace, the material in question is of such a nature that (as for instance the *Cassiope*-leaves) it decays very slowly, and certainly with a greater tendency to peat-formation than to the formation of mild humus. Even manured spots are not capable of producing a richer life, although these appear to be able to offer an equivalent to the presumed advantage of greater distance from the coast, as the conditions on Maroussia indicate.

Around skulls and other parts of skeletons, beautifully green oases in the surrounding desert are often to be seen, even from a distance; and in this relative luxuriance may grow vigorous tufts of *Melandrium triflorum* and *Hierochloë*, as also *Cerastiums* and *Stellaria longipes* with elongated internodes, the thick-leaved *Saxifraga cernua*, and the inevitable *Polygonum viviparum*. A similar though less decided luxuriance is sometimes due to the manure around lemming-holes.

As regards the development of Formations, at the outset, water is the most important factor: how much or how little and under what circumstances it is conveyed to the ground is the momentous point here, far more than the nature of the soil. From an orographical point of view, great uniformity prevails. As regards the solid elements, the maritime country consists of "moutonnées" primitive rocks of a height of as much as about 400 metres; further into the country, around Mörkefjord and Pustervig, a table-land occurs; its greatest height, 812 metres, is reached in Stjernefjeldene. Fuglenæbsfjeld, which I visited in August 1906 is of about the same height. The surface which slopes gently towards the north consists of loose boulders with intervening large, flat patches of gravel, the vegetation of which is sparingly-occurring tufts of *Saxifraga oppositifolia.*

Loose material, consisting of clay and gravel, is present to a great extent as moraine-formations around Stormelven and the inner part of Dove Bay. The depth of these layers is of no consequence, as the frost binds the ground into a frozen mass at a short distance from the surface. The extent of this distance is of course dependent upon the degree of moisture which is conveyed to the soil. It is true that, in the case of gravel-mounds which occurred scattered like those near Stormelven and the Bastions near Lakseely, the mass of earth thaws rather far down, but then the surface is so dry that there is nothing to foster the growth of plants; consequently, it is barren there. As a rule the soil is not utilized to a greater depth than about 6 cm.

Plants are offered somewhat better conditions in places where the more recent layer is found deposited in depressions either entirely or partly surrounded by the primitive rocks, but with such possibilities of outlet that the water is not higher than some parts of it and the ground may protrude and allow the formation of tufts. In such places I always found *Carex pulla*, *Arctagrostis latifolia* and occasionally *Juncus triglumus.*

If the loose deposits are absent from the bottom of such a depression it is converted into a water-filled basin with a stony bottom devoid of vegetation. Where this kind of small pond becomes dry, the bottom is found to be black with *Gloeocapsa* and *Phormidium autumnale.*

Where the gravel and clay layers are found deposited in depressions between higher masses of rocks, so that there is enough moisture throughout the summer, *Carex*-bogs are developed as, e. g. in Vesterdalen between Harefjeldet and Varderyggen and in the valley east of the latter.

Slightly sloping or horizontal gravel-deposits, which in the first part of summer (June) are continually irrigated by melting snow, soon form a flourishing bog of *Eriophorum polystachyum* from which *Arctagrostis latifolia* is rarely wanting.

The rocky flat proper is formed by the gravel and clay layers to which must suffice the moisture which either the snow which covers the spot or the adjacent drifts of snow can provide from the time when the snow begins to melt in spring. These constitute by far the largest part of the area (with loose material), and it is the only formation which exhibits some alternation in the composition

Fig. 8. Slope with *Dryas* near Snenæs. In the foreground luxuriant mats of *Dryas* (30. 6. 1908).

of its vegetation. As a formation it also includes the scattered sparing vegetation of the primitive rocks.

Nature in its entirety has a stingy hand in these regions; poverty peeps through everywhere, and any extent of sociability cannot be afforded. Not even the most robust proletarian dares to associate in large quantities for fear of mutual deprivation of sustenance. If ultimately some associations are formed, e. g. the *Carex*-bogs along the small streams, the societies are always very exclusive, though not in the sense that the members exact too much of life: a drink of water during summer and a covering of snow during winter is all that they demand.

I will take the permission to quote from my diary the impressions I received during a visit in the summer of 1908 to Kløftfjeldet between Snenæs and Lille Snenæs: the slope there in my opinion is one of the most beautiful in north-east Greenland.

"There is an apparently enormous luxuriancy upon the irrigated terraced hill-side facing south-west. Here is a valley below in a direction about west to east. The south wind alone blows directly against it. And then there is water here, and water will continue to flow for a long time yet. Today it is July 7, and it has been very warm considering the time of year. Consequently, we must expect to find at any rate indications of everything which subsequently will make its appearance, because in 7 or 8 weeks we may have frost again, as we had it last year on Sept. 1.

But wherein does this luxuriancy consist? Well, there is a continuous carpet of vigorous specimens of *Salix*, richly flowering *Cassiope*, and luxuriant broad-leaved *Dryas*. *Vaccinium* has fresh, green shoots everywhere and flowers here and there. Then — of-course — there is never-ending abundance of *Polygonum viviparum* — this intruder which does not leave any society in peace. *Dryas* has almost finished flowering in the drier places. Thus, the terraced slope, seen from below, looks very well; but as soon as one has ascended, nothing of this is seen, as the most luxuriant vegetation occurs upon the slopes of the terraces (especially upon the more abrupt ones) and is hidden by their edges (Fig. 8).

And then what is my reward when I come upon the top of the hill: flowering *Campanula!* That is the culmination here! Under similar conditions in West Greenland, e. g. on Præstefjeldet, I found *Alchemilla*, *Thalictrum*, *Veronica* and *Bartsia* on June 2, 1905, and tall willow-copses along the banks of the small water-courses. Here it is only a question of the willow flinging itself along the rock and adhering to it, just barely venturing its catkins as far out as possible.

The greensward hereabouts is formed by *Luzula*, *Hierochlöe* (of course), a few *Poa cenisia* and *Cobresia Bellardii* together with *Carices* such as *C. misandra* and *Carex rigida*."

These few species supplemented by *Rhododendron*, which I found in the same society in Pustervig, on Fuglenæbsfjeldet and on Muskusoksefjeldene, are the only attempt towards the formation of a heath I ever found, with the exception of a small society of *Empetrum* intermixed with *Salix herbacea* near Hulesöen.

Of the peculiar formations which I have met with I shall here mention only a remarkable patch near the shore at the head of Yderbugt which I found on July 28, 1907. The ground is level and is only a few metres above sea-level at high tide. The surface is

dark and has white patches as of salt. The patches are due to a lichen, doubtless a *Lecidea* which has occurred in many places, but never bearing fruit. Not far from here the primitive rock outcrops at an inconsiderable height.

Scattered over a belt of about 20 metres in length and 30 metres in breadth there occurred here a peculiar community of flowering *Papaver* which was conspicuous even from some distance. With intervening spaces, ranging from a few cm. to above one metre, the plant stood here and flowered richly. The ground was also covered with a rich vegetation of *Cochlearia officinalis* L. var. *groenlandica,* f. *minor* (Lge.) Gelert, which however in the flowering-stage greatly resembles the white lichen-spots. Also *Draba arctica,* a single specimen of *Luzula confusa* and *Phippsia algida* were present. *Saxifraga rivularis,* which is certain to occur in small depressions where melted snow has flowed, does not count for much, but is nevertheless found in the community. Here and there is found a small *Sagina intermedia* and *Alsine verna* f. *rubella,* c. fl. A single tuft of *Saxifraga groenlandica* was also noted. In the inner part of the belt, i. e. towards the primitive rocks, were found *Draba fladnizensis, Saxifraga nivalis, S. cernua* and *S. oppositifolia* together with indications of *Salix* and *Cerastium.* The transition to true rocky flat is indicated not only by the *Salix,* but also by tufts of *Poa abbreviata* and by a more frequent occurrence of *Saxifraga nivalis* and *S. oppositifolia.* These two species are not found in the lower part of the community, while *Cochlearia* and *Papaver* occur commonly everywhere. As soon as one leaves this community in a very true sense of the word, *Papaver* becomes rare and *Potentilla emarginata* takes its place. Here *Salix,* with a few *Stellaria longipes,* becomes dominant. In this community, *Papaver* and *Cochlearia* dominate. I was surprised not to find *Pedicularis* where *Salix* and *Potentilla emarginata* occurred.

I found a very conspicuous community on July 5, 1908, upon Kløftfjeldet where *Epilobium* was spreading out with great splendour upon flat gravelly tracts through which tiny water-courses were flowing. But there the plant was far from reaching the size attained in West Greenland.

On the same day, upon the rocky flat between Snenæs and Lille Snenæs, I came across a small patch which from a distance attracted my attention by its yellow colour, and which, *a priori,* I thought resulted from *Papaver,* but on closer inspection it proved to originate from a richly flowering clump of *Potentilla nivea* upon a gravelly slope facing south which apparently afforded a convenient dwelling for a family of foxes whose continual use of the passages

was revealed by the loose hairs found in them. This association of *P. nivea* was pure; only at the outer edge a single *P. emarginata* was found. Some exceedingly vigorous tufts of *Poa abbreviata* proved that the latter also throve in the neighbourhood of the fox-hole.

Between Stormkap and Snenæs the ground is fairly level and only slightly elevated. There are many small lakes and small bogs of *Eriophorum polystachym* of the usual monotonous composition, i. e. with *Carex pulla* and *Arctagrostis latifolia*. Where the ground is drier, *Salix*, *Cassiope* and *Hierochloë* dominate. Also the following occur scattered — *Papaver*, *Polygonum*, a small-leaved *Dryas*, *Luzula confusa*, *Cobresia Bellardii*, *Carex nardina*, *C. rupestris*, *Poa abbreviata*, *P. glauca*, *Melandrium affine*, *Silene*, *Stellaria lougipes*, *Saxifraga oppositifolia*, *S. cernua* and *Potentilla emarginata*.

During an excursion from Lille Snenæs to Trekroner on June 27, 1908, I found the first and only plant belonging to N. O. *Liliaceæ* in these regions, viz. *Tofieldia coccinea*, whose northern limit was thereby removed above 4 degrees of latitude further north. It was not exactly what I had expected to find. It formed very compact and dense tufts, sometimes alone, and sometimes together with *Cassiope* or *Dryas*. The roots twined so closely together that they could scarcely be separated without being torn. Neither *Cassiope* nor *Dryas* was flowering as yet, so the snow must have been lying a long time. *Tofieldia*'s nearest neighbours were *Vaccinium*, *Polygonum*, *Silene*, *Juncus biglumis*, *Pedicularis hirsuta*, *Salix* and a specimen of *Carex* (*rupestris* ?); also a small poor-looking *Papaver* which did not appear to thrive in these surroundings. These are without doubt the plant-growth of a heather-moor, but they occur here under such modified conditions that they do not constitute a formation which can be included in the definition of a heather-moor, with the significance that the word has when used in connection with West Greenland. The whole of this small locality consisted of a depression about 70 metres above sea-level.

In the dry sandy deserts north of Lumskebugten the vegetation consisted of only *Saxifraga oppositifolia*, *Carex nardina* and a few specimens of *Salix*. Further north there was quite a flat area covered almost exclusively with *Dryas* which had here very narrow leaves with revolute margins so that it closely resembled *Dryas integrifolia*. Below the snowdrifts at the foot of the small hills occurred the largest and flattest bogs of *Carex* and *Eriophorum* that I ever saw. The ground being so flat, these bogs looked exceedingly pleasant when seen from a distance, but, viewed nearer they did not appear to such advantage. To a certain extent they were reminiscent of the tufted bogs in Denmark, only the tufts here were very low and

without the usual packing of moss with which we are acquainted in our bogs. There is running water almost everywhere.

There were also tracts which reminded one of the sandy *Calluna* heaths ("Hedesande") of Jutland where the fire has burnt off the surface layer. Here were tufts of *Dryas* which were not yet in flower (June 27), and flowering *Saxifraga oppositifolia; Oxyria* enlivens the scene wonderfully with its splendid inflorescences, but *Carex nardina* of course was not absent from the group, nor failed to give the whole a gloomy, withering and dying appearance. Fine, loose sand occurred between the tufts.

If moisture supervenes then we get in addition *Salix, Statice* and *Hierochloë.* Then *Dryas* comes into flower and then there is also a chance for *Carex misandra.* Moss occurs very sparingly even if there is water. But the water which stood there then would soon evaporate, and then the whole area would be dry. When seen from a distance such wet spots stand out like magnificient oases in the gravel and stone desert.

In towards the south-east side of Trekroner I saw the mountain in its most forbidding aspect. For a distance of several hundred metres the primitive rock was found torn up by the disruptive power of frost, so block was found by block in wild chaos without the least particle of loose material between them; consequently, all higher plant-life was absent.

In a single place at Lumskebugten there was found an attempt towards the formation of downs. At the foot of a bank of quicksand between two river-mouths some small individuals of *Alopecurus* and *Festuca ovina* occurred — the latter was viviparous there; also *Poa abbreviata, Poa cenisia* and *Luzula confusa* were found. Somewhat higher up were *Carex nardina*, sand-covered *Papavers* and tufts of *Alsine rubella.* I wondered at the occurrence of *Trisetum* in this society which, in addition, contained sand-covered *Salix, Lesquerella, Dryas, Saxifraga oppositifolia* and *Silene,* all bearing the stamp of the particular conditions in which they occurred.

As examples of typical localities I may mention my tent-ground at Lille Snenæs and the parts around the station at Danmarks Havn. The illustration from Lille Snenæs was taken on June 30, 1908 (Fig. 9). The tent was pitched on June 1 upon a small, flat patch of gravel which at that time was lying like an island in the snow, about 4—5 metres above sea-level (Fig. 10). Further out, the shore was formed by the primitive rock and a quantity of loose blocks and large stones which protruded through the ice-foot — and lay somewhat inwards upon the land. This outermost part was almost free from snow when I arrived there on the morning of June 22. Even at

Fig. 9. The tenting-place seen from the south. (Lille Snenæs; 6. 30. 1908).

Fig. 10. The tent seen from the north. "Orienteringssøerne" in the background. (Lille Snenæs; June 1).

that time *Cochlearia* was flowering between the stones upon the shore; a week into July *Stellaria humifusa* came into flower there; somewhat higher up a single *Braya* occurred. *Cochlearia* and *Stellaria* were alone within their dominion where the snow had been lying for a relatively long time. The rest of the large snowdrift above the tent did not disappear until July 9. The direction of the place is about S.—N. and it is protected towards the east by an edge, a few metres high, of the primitive rock which further inwards was covered by loose masses of gravel and clay — an old sea-bed and an old shore-formation. The snowdrift in towards this rock-edge, as also the snow on the whole, presumably had disappeared earlier than in 1907. And yet it was barren where it had been lying, which indicated that often it did not succeed in melting during the course of one summer. In the uppermost northern part of the place which had been occupied by the snowdrift, *Cochlearia* f. *minor* stood in flower on July 9. Though *Salix* ventured near to the places where the snow lay longest, yet it was not found where the snow had last disappeared. In the somewhat lower ground, between the snow and the more stony and somewhat higher part around the tent, distinctly marked belts of *Alopecurus* occur, about one metre in breadth; also *Luzula confusa*. Between the tent and these belts occur in a scattered manner — *Papaver*, *Oxyria* and *Salix*, as also *Cardamine bellidifolia; Glyceria angustata*, *Alopecurus*, *Cerastium*, *Stellaria longipes*, *Saxifraga oppositifolia*, *Potentilla emarginata* and *Juncus biglumis* extend inwards towards the lower, southern part of the snowdrift which at the extreme outside merged into the ice-foot. Where the ground sloped upwards against the rock-edge and the surface was damp and had cracked into polygonal cakes (a kind of "Rudemark") there nothing had appeared as yet (July 9), and there it was quite barren next the snow below the highest edge of the rock. Where the snow had just disappeared from the lowest part, not even moss was found.

In the most northerly part of the area from which the snow first disappeared, the above-mentioned belt of *Alopecurus* had wedged itself in between the foot of the edge of rock and a lower belt of *Luzula* which grew in tufts upon the polygonal cakes and imparted a greenish-brown tone of colour to the ground. Into this community there had ventured also a few specimens of *Poa*, *Oxyria*, *Salix* and *Potentilla emarginata*. There *Oxyria* had begun to flower, and there a single, fresh shoot of *Cerastium alpinum* was also found. Just at the edge of the belt towards the north, where it becomes more dry, a solitary *Saxifraga cernua* occurred. Here, and further in beneath

the snowdrift, the lemming had left three holes, and a dead lemming was lying upon the ground.

Outside this belt of *Luzula*, somewhat lower, and sloping slightly towards the gravel patch on which the tent stood, came the *Salix*-belt which on July 9 was intermixed with crowds of flowering *Pedicularis*, and next to the gravel patch with numerous *Polygonums*, a few *Papavers, Potentilla emarginata* and *Silene.* On the western edge, in the outermost part of the belt which is about 10 metres broad, *Salix* had finished flowering, while in the inner part it had just begun. At the border there were a few tufts of *Cobresia Bellardii*,

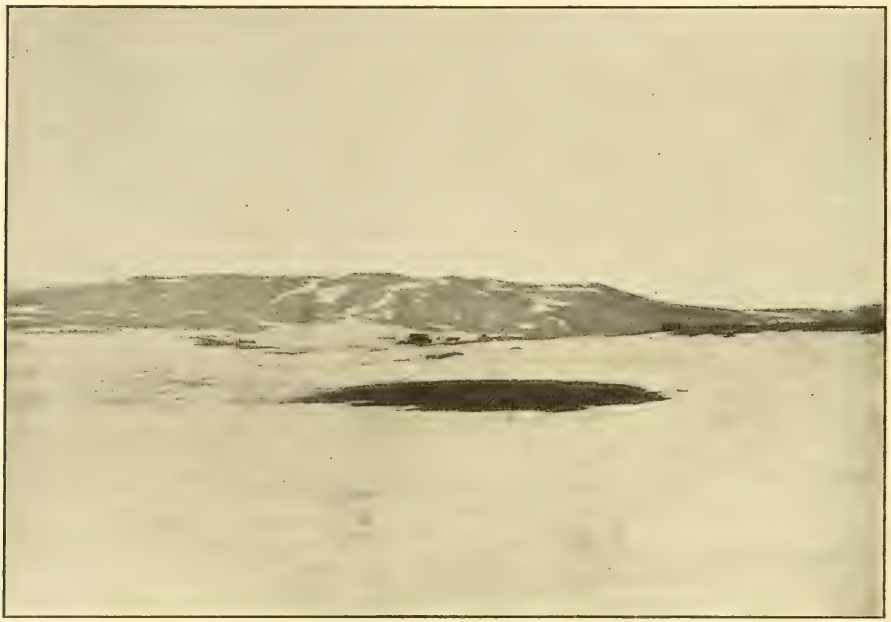


Fig. 11. "The Island" ("Øen").

while *Hierochloë*, *Carex misandra* and *Luzula* occurred here and there. Around the tent occurred *Melandrium*, *Lesquerella* and *Potentilla pulchella*, as also *Arenaria ciliata, Dryas, Taraxacum phymatocarpum* and *Alsine rubella.*

Point I upon the map of the station which was the "Danmark's" winter quarter, I have called "The Island" (Øen). As may be seen from the map and the illustration (Fig. 11), the ground west of the mouth of Øster Elven slopes gently from the 6-metre curve down to the shore which is here quite flat. During the melting of the snow, Point I at first emerged as a small island which daily increased in size, and there already on June 14, 1908, a *Draba alpina* was in flower. In the saturated soil around the plant a temperature of

— 10° was measured on the above-mentioned day, at 10.50 a. m., at a depth of 4 cm.; beside it in slowly running water, the thermometer showed + 9.3°, in dry sand + 10.5°; and in the air + 0.5°.

The conditions at this spot are favourable: sloping ground with a southern aspect and plenty of moisture, which features serve to minimize the difference between the day and night temperatures. The illustration was taken on June 15, 1908. At that time was found *Saxifraga oppositifolia* which predominates in the assemblage and as a great part of it was already flowering it gave a colour-tone among the black surroundings, where also the yellowish-grey tufts of *Carex misandra* were seen. Soon came the species next in conspicuousness, *Pedicularis hirsuta*, which was already peeping out with its fresh shoots in the drier spots. *Salix* also was flowering. *Saxifraga nivalis* and *Papaver* occurred with fresh rosettes, and *Ranunculus glacialis* was almost out. Moreover fresh shoots were seen on *Silene, Alsine verna, Cerastium alpinum* and *Potentilla emarginata*. In one place *Melandrium affine* stood alone, still with its stems of the previous year. *Stellaria longipes* was lying with apparent indifference still in its winter-clothes; but a closer inspection showed that in it also there was life in the nooks and corners of the tufts. *Draba hirta* had fresh rosettes; also *Luzula confusa*, a *Poa* and a few tufts of *Festuca ovina* showed the first signs of reawakening life. Add to this green algæ in the small pools, and the *Nostoc*-lumps in the running water, these all taken together formed a picture of a small, isolated, favourably-situated spot in spring-attire.

When I returned home from Lille Snenæs on July 2 "The Island" was covered with flowering poppies. There was still something left of the snowdrift along the 6-metre curve, where the cross-hatched part indicates a pronounced *Cassiope*-locality. In that part of "The Island" which was the first to become free from snow *Saxifraga oppositifolia* had already almost finished flowering. But *S. flagellaris* was in flower and some unusually luxuriant *Cerastium*-tufts, the flowers of which measured 20 mm. (cf. List, p. 20, the note to *Cerastium*; the illustration (Fig. 12) shows a tuft with stems stretched out and lying prostrate upon the ground). Towards the *Cassiope*-slope, at about the 5-metre curve, *Cerastium alpinum* f. *pulvinata* Simm. occurred here and there. It lay for a long time hidden under the snowdrift and in 1907 did not appear until the month of August; the next year it was at that stage of development even before our departure on July 21. At the same level, between the *Cassiope*-belt and the small masses of primitive rocks nearer to the water, *Alsine biflora* was found (cf. List, p. 18). Later in the summer the ground becomes dry and the surface cracks into polygonal cakes (a kind

of "Rudemark"); but the cracks did not become so deep here as I saw them in several other places under similar circumstances. True "Rudemarks" probably do not occur at all in Germania Land; they were indicated most decidedly where the snow had been lying so far into August that the ground did not succeed in producing any vegetation at all.

On July 17, 1908, were found in addition upon "The Island" *Draba subcapitata*, *D. fladnizensis*, *Sagina intermedia*, *Ranunculus pygmæus*, *Taraxacum arcticum* f. *albiflora* (Fig. 14), *Oxyria digyna* and *Glyceria maritima* f. *reptans*.

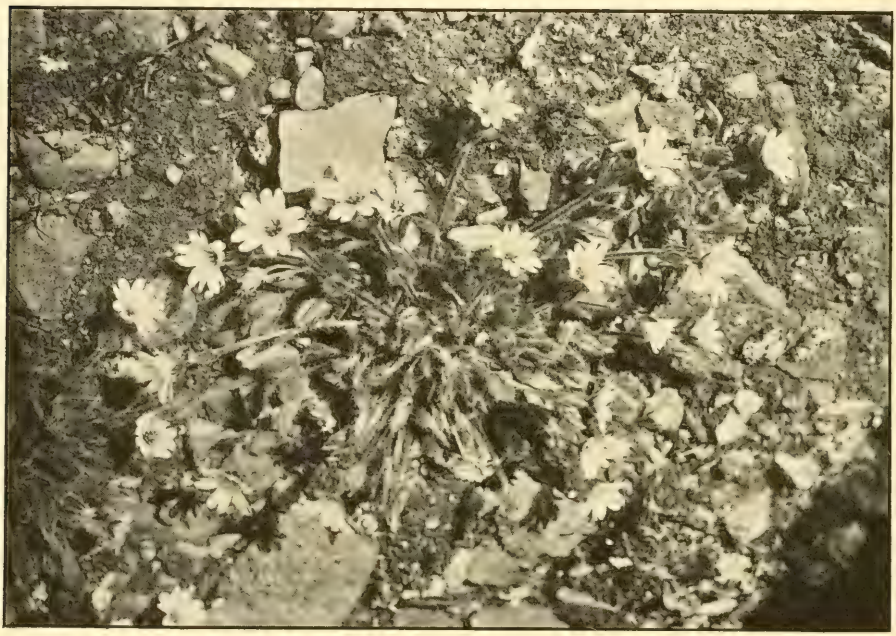


Fig. 12. Tuft of *Cerastium alpinum* with espalier-like growth (2. 7. 1908).

The following table shows 48 species which have been found upon "The Island", the tenting ground near Lille Snenæs and in the *Papaver*-association near Yderbugten (July 28, 1907). Consequently, in these three diminutive localities occurs one-half of all the species which have been found, which, it appears to me, is a proof of the monotony of the vegetation in these regions. These three habitats are designated A. B. C. respectively, and the species found are indicated by a ×.

In regard to 8 species it is known for certain that they occurred in all three habitats. *Poa*, as a 9th species, is uncertain, as in the stage of development in which it was found in all three instances it was impossible to determine it as species. Characteristic of the

		A	B	C
1.	*Juncus biglumis*		×	
2.	*Luzula confusa*	×	×	×
3.	*Cobresia Bellardii*		×	
4.	*Carex misandra*	×	×	
5.	*Hierochloë alpina*		×	
6.	*Alopecurus alpinus*		×	
7.	*Phippsia algida*			×
8.	*Glyceria angustata*		×	
9.	— *maritima*	×		
10.	*Poa (glauca?)*	×	×	×
11.	*Festuca ovina*	×		
12.	*Salix arctica*	×	×	×
13.	*Polygonum viviparum*		×	
14.	*Oxyria digyna*	×	×	
15.	*Melandrium affine*	×	×	
16.	*Silene acaulis*	×	×	
17.	*Arenaria ciliata*		×	
18.	*Alsine verna*	×	×	×
19.	— *biflora*	×		
20.	*Sagina intermedia*	×		×
21.	*Stellaria humifusa*		×	
22.	— *longipes*	×	×	×
23.	*Cerastium alpinum*	×	×	×
24.	— f. *pulvinata*	×		
25.	*Ranunculus glacialis*	×		
26.	— *pygmæus*	×		
27.	*Papaver radicatum*	×	×	×
28.	*Cochlearia officinalis*		×	×
29.	*Cardamine bellidifolia*		×	
30.	*Lesquerella arctica*		×	
31.	*Draba hirta*	×		×
32.	— *fladnizensis*	×		×
33.	— *subcapitata*	×		
34.	— *alpina*	×		
35.	*Braya purpurascens*		×	
36.	*Saxifraga oppositifolia*	×	×	×
37.	— *flagellaris*	×		
38.	— *cernua*		×	×
39.	— *rivularis*			×
40.	— *groenlandica*			×
41.	— *nivalis*	×		×

	A	B	C
42. *Potentilla pulchella*		×	
43. — *emarginata*	×	×	×
44. *Dryas octopetala*		×	
45. *Cassiope tetragona*	×		
46. *Pedicularis hirsuta*	×	×	
47. *Taraxacum arcticum*	×		
48. — *phymatocarpum*		×	
Total...	29	30	18

coastal regions there is only *Saxifraga flagellaris* which was absent from the area around Dove Bugt and occurred again on Ymers Nunatak. In this intermediate space, as also on Ymers Nunatak, *Potentilla pulchella* was found which in the coastal regions (around Dan-

Fig. 13. *Ranunculus glacialis.*

marks Havn) had been found only as a single individual on Harefjeld—and again on Maroussia. Without however instituting any connection between the two circumstances of simultaneous occurrence I shall only remark that I found the plant for the first time when, on September 1, 1907, I was with the geologist of the Expedition at a place near Dove Bugt where he, at the same time, found Yoldia-clay.

Point II upon the map of the station indicates a small pond which dried up some time in the course of the summer and was again refilled by the ground-water from the bog above. In the near surroundings of the pond, towards the west, occurred in early summer a rich growth of *Ranunculus glacialis* (Fig. 13) which gradually became intermixed with *Statice armeria* which appears to thrive in the conditions which occur there late in the year.

Point III, upon the flat gravelly field, was the only locality in immediate proximity to the station where *Arenaria*, which was common further into the country, was found. In similar localities

Fig. 14. *Taraxacum arcticum* (Trautv.) Dahlst. f. *albiflora*.

but higher up and on a solid stony bottom, deeply covered with snow during the winter, *Erigeron compositus* was found; it keeps to the southern side and extends upwards, as far as the ground reaches which has previously been a sea-bottom.

The speciality of the small clay-island (Lerö), which is designated Point IV, was *Equisetum arvense* together with a luxuriant growth of *Salix*, *Dryas* and *Draba*. The depression around Point V is filled with snow during winter, and decaying parts of plants also gather there; upon the whole the locality appeared to offer possibilities for the formation of humus; nevertheless its only inhabitants after the melting of the snow were a small association of white-flowering *Taraxacum arcticum* (Fig. 14). Similar localities, especially if

watered with running water for some time, were agreeable to *Ranunculus pygmæus* and *Saxifraga rivularis*.

Just above the *Cassiope*-belt north of "The Island" (Point I) the edge of the 9-metre curve was formed by a continuous growth of *Dryas* which kept to the level, dry margin, and did not extend over it in places where it ended abruptly. But *Cassiope* does not care to climb over any edge which does not retain its snow-covering very long; and thus *Vaccinium* is afforded an opportunity for growth

Fig. 15. *Empetrum*-locality to the east of Hulesöen. In the foreground, under the snow, *Empetrum* and *Salix herbacea*. On the margin above, the *Vaccinium*-belt, between *Dryas* upon the level flat and the *Cassiope*-vegetation which begins at the edge of the snow (9. 6. 1908).

between *Dryas* and *Cassiope*, and there it is often found in a sharply defined belt of 20—30 cm.; it occurs almost exclusively on such somewhat rounded surfaces transitional between more level areas and depressions in the ground. *Vaccinium* was found in a specially well-marked area and under such conditions east of Hulesö, where a large, level tract consisted of an *Eriophorum*-bog of copious moisture derived from an enormous snowdrift towards the north-east. A rather broad dyke formed a boundary to the bog and was broken through by small outlets from it. Upon this dyke *Dryas* and *Vaccinium* were distributed as described above. A depression of about one metre in depth contained some luxuriant tufts of *Empetrum*

intermixed with *Salix herbacea* which latter did not occur outside this locality (Fig. 15; see also Fig. 5).

North of this *Cassiope*-belt and *Dryas*-border the vegetation became sparse, consisting only of some tufts of, e. g. *Carex nardina* and *Poa abbreviata*. The most northerly part of Basiskær seen upon the map has become drained. There are dark masses of barren clay, and the surrounding parts consist of tufted *Carex*-bog of which the principal contents are mosses, *Carex pulla*, *Arctagrostis* and *Salix*. Towards the north-west, in the dampest part between pools and water-courses, vigorous individuals of *Ranunculus sulphureus* occurred

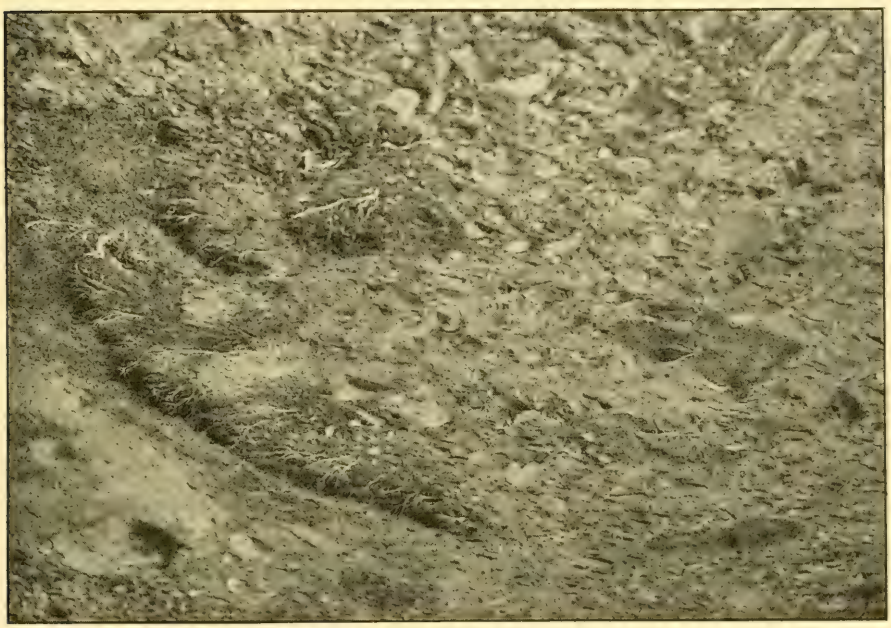


Fig. 16. Wind-affected forms of *Dryas*.

and, hidden in mosses, *Juncus biglumis* together with *Cardamine bellidifolia*. At a short distance from that place *Pleuropogon* was floating, late in the summer, in that part of the river which was the first to dry up when frost set in.

Though the area included in the map is limited, yet this patch of ground and its immediate surroundings are relatively rich in the representatives of the vegetation of Germania Land; and I venture to hope that the area may be of interest as a useful illustration *en détail*, on account of the notes I have added upon it.

As peculiar wind-affected forms occur the worn-off tufts especially of *Cobresia Bellardii* and *Carex nardina*, as also of *Silene* and *Dryas*. The illustration of the *Dryas*-tuft (Fig. 16) is of one from

the district near Lakseelv, found on June 16, 1907; it measures 2.32 metres in length and 1.45 metre in breadth and is almost withered to windward (NW.) and in the middle, but has a vigorous, though wind-affected border, to leeward. But these tufts keep to the ground and thereby stand in contrast with the curious "column"-forms in which *Potentilla pulchella* occurs both on Ymers Nunatak and in those places upon the gravel-banks near Lille Snenæs which are most exposed to the wind. The individuals from Ymers Nunatak appeared to have struggled against the sand-drift and thereby to have attained the compact, high tuft-form in order that they may be able to keep "above water." But the individuals of this form which I myself collected, stood quite isolated over the field and showed a much wind-affected and leafless base. The conditions there did not in any way permit the sand to gather around these "columns." *Lesquerella* and a *Draba* sp. from the same exposed posts have the same form (cf. List, p. 23 and Pl. V). It appears to me, judging from my observations in the field, that the form *humilis* (Lange) of *P. pulchella* prefers the weather-side to the lee-side though it is found also in that situation in company with *P. nivea.* But on the lee-side the tufts appear far fresher and have always a broad base.

P. pulchella f. *elatior* (Lange) is often found upon high sloping river-banks consisting of loose sand mixed with clay; but in contradistinction to the xerophilous f. *humilis* with its densely hairy, silvery white leaves f. *elatior* has slightly hairy leaves which are green upon the upper surface. In such places it must often stretch far and wide for food; I have found it with roots which measured 1.15 metre and to a great extent were lying so high that a portion of them lay bare.

It seems to me that *Salix* also must allow its form to be determined by such external factors as the wind. The illustration (Fig. 17) shows the largest "copse" I have seen; it occurred upon a stony slope above the station in Pustervig. *Salix* often adopts a curious form according to the adverse circumstances it meets with, but it always keeps close to the ground. The most beautiful branches I have seen I found upon Harefjeld on June 24, 1907. They were two 13-years-old branches, ♂ and ♀, measuring respectively 48 and 57 cm. in length. The male branch was somewhat thicker than the female which had a year's-shoot measuring 9 cm. and bore a leaf the blade of which measured 51 × 30 mm. The leaves were slightly hairy and the branches smooth. The exposition was as favourable as possible as regards shelter, snow-covering and sun. The male catkins expand first, and upon level ground always earliest in that part of the catkin which faces south.

Saxifraga cernua is a remarkably variable species, though not in response to the conditions of the wind. Its form differs according to the different localities, but it makes its way everywhere: on dry rocky flats where it grows up and becomes large and beautiful in the shelter of a boulder, as well as upon a manured spot around an animal skeleton where it utilises the sources of nourishment to excess and develops thick, swollen and brittle leaves; or along small water-courses down the rocky slopes with a gravelly bottom, but in such a case it rarely flowers until very late; and lastly in bogs and near lakes in the wettest moss, where it scatters its bulbils very

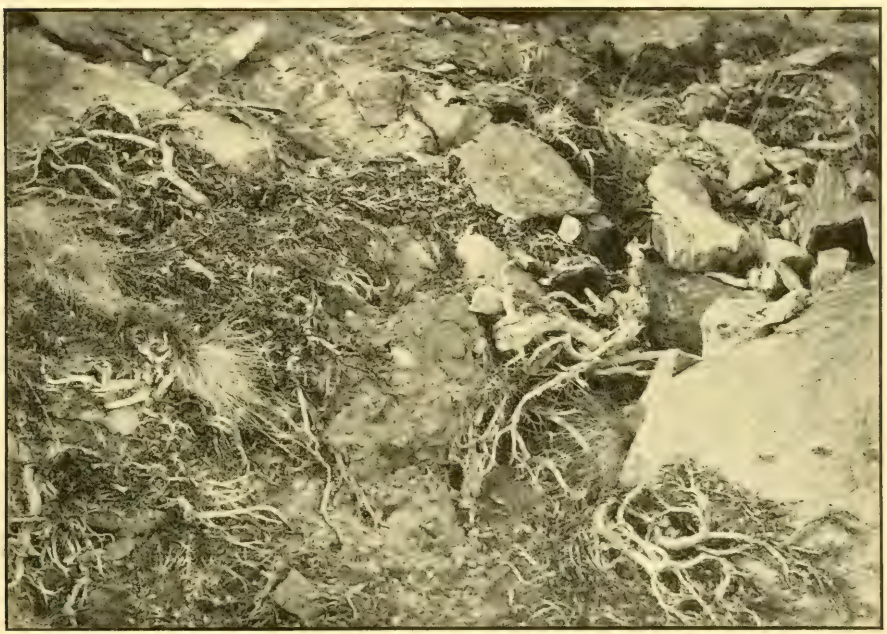


Fig. 17. Willow-copse at Pustervig.

abundantly. Flowers are of secondary importance to it. Here it stands long and straggling — both large and small individuals — and so dense that it characterizes the locality yet without adorning the landscape. The bulbils germinate also upon the parent plant, in the axils of the withered leaves.

Saxifraga groenlandica was found to be almost fully expanded on May 20, 1907, in a valley which lies N.W.—S.E. near Termometer-fjeld. It was still snow-covered, but received moisture from snow which, in the form of an ice-collar, hung beyond the small tuft, whose one-year-old stems with withered flowers were protruding. The exposition was southern and shelter was obtained from some stones towards the west and the mountains towards the north and

east. The two almost expanded flowers had their development stopped when the snow-layer melted round the tuft and on May 28 they were found to have closed, and no other buds had opened. Not until June 8 were some other buds on longer stems fairly widely open.

Epilobium latifolium is protandrous according to the material first collected by me. Afterwards I investigated some flowers on Moskusoksefjeldene on July 9, 1908, and in them frequently found the style to be further developed relatively to the anthers; I regard protandry to be the most common condition in north-east Greenland. (See also Warming, 1886, in K. Danske Videnskab. Selsk. Oversigt, p. 141, fig. 11).

In 1908 I found the plant in flower on July 7. In the material collected there were also fruits from the previous year, though the summer of 1907 might be regarded as unfavourable, as a relatively low temperature had prevailed during the whole time; therefore it is beyond doubt that the species in the summer of 1908 had set fruit in the majority of the localities in which it reached the flowering-stage as early as the beginning of July. The power of the species to spread below the soil is indisputable; but it is not of necessity of value to the preservation of the plant. Whether the seeds are dispersed by the agency of birds or by the wind or by both I am not prepared to say; but one of these two factors must have been at the disposal of the plant in one case, in which I found the plant in a crack in the rock at some distance from its original locality. It can scarcely have found its way there otherwise than through seeds. (The possibility is not excluded that the seed had been transported by the agency of running water; but this did not occur to me when I saw the plant on the spot and now, after some time has elapsed, nothing can be stated with certainly either for or against such a possibility).

Stellaria humifusa Rottböll. On August 12, 1907, I observed the plant on the shore at Yderbugt where it was visited by a small, grey butterfly which returned to the same tuft over and over again. The flower is decidedly protandrous; the anthers were empty when the stigmas were ripe. The head of the insect-visitor was dusted with pollen from a young flower, but it appeared to be very fond of older flowers also; the insect licked the petals and the ovary of the latter, but also stood head downwards in order to be able to reach the lower part of the flowers; it also tried to thrust itself in between the sepals from the outside. (See also Warming, 1890, in Festskrift udgivet af Den botaniske Forening, p. 212, fig. 8).

Stellaria longipes Goldie. On August 11, 1907, I observed small Diptera visit the plant. (See also Warming 1890 l. c., p. 207, fig. 6).

This species varies highly and appears to understand fully the art of adaption and its signification. Near places where food is plentiful — as in the manured spots around parts of skeletons of the musk-oxen — and also where it is protected by surrounding grass-tufts its internodes always become greatly elongated. On June 16, 1907, I found near Hvalrosodde stems apparently quite dead, with fresh, green buds and green leaves in their upper part. And on May 23, 1908, I came across several places on dry ground where, also upon withered old plants there occurred fresh buds, although the whole was so frozen and dry that it crumbled between my fingers.

Arenaria ciliata (L) var. *humifusa* (Wahlenb.). This plant has decidedly protandrous, insect-pollinated flowers. Honey is secreted abundantly in five glands at the base of the stamens in front of the sepals, and it sometimes occurs in clear beads at the base and gives to the plant a strong, sweetish perfume recalling that of buck-wheat (*Polygonum fagopyrum*) or heather (*Calluna vulgaris).* Where the plant occurs in large quantities in a locality it colours the ground as if with balls of snow of purest white; but these white cushions are not very conspicuous when the sun stands high in the sky because in that case they harmonize too closely with the light, clayey soil mixed with sand which this species especially prefers and which, only when otherwise illuminated, presents enough contrast to show up the plant. The perfume is evidently sufficient to attract insects.

This species occurs most frequently with five styles. When only three styles are present these appear to be shorter than in the flowers which are 5-merous, and in contradistinction to such they stand erect and with their reddish-purple stigmas placed closely together. (See Warming, 1890, l. c. p. 221, fig. 14).

On September 4, 1907, this species was flowering on the west side of Varderyggen where it occurs as a spring plant which, in spite of frost, bears fresh shoots; however, the stamp of autumn was imparted by the reddish-brown colour of the young leaves.

Cerastium alpinum L. On May 21, 1908, a tuft was found with flowers that had survived the winter. New, fresh shoots were easily recognizable in the tuft. On the 23rd of the month I found several specimens with flowers from the previous year, as fresh to look at as if newly expanded, had not the protruding seed-capsule betrayed their age. The plant stood under the snow in the shelter of some stones — the protection being lowest towards east — in a depression where the plant must have been covered with snow from the first snowy day in September. Already for a long time the sun's heat

had been penetrating the snow-covering, therefore the under part of the snow-crust and the upper layer of the soil, especially that which stood highest (to the north), was frozen ice. Here also a *Melandrium* was found. The soil around the *Cerastium* and at its root was quite dry, as dry as dust. The plant had fresh shoots besides green leaves that had remained through the winter. (For the biology of the flower see Warming, 1890, Festskrift, p. 197, figs. 1, 2).

Ranunculus glacialis L. Homogamy the rule. The nectar-pit is without a scale. (For the biology of the flower see Knud Jessen in Meddel. o. Grönland XXXVI, p. 338, fig. 3).

Within the *Cruciferæ* there is a considerable contrast between *Lesquerella arctica,* which is decidedly xerophilous (as also *Braya* in part) and the majority of the *Drabas*, most of which may be found both in dry and in damp soil. *Draba glacialis* associates itself with any other plant (as also does *Cardamine bellidifolia*) both in the driest gravel and in the wettest moss; and no change can be observed in its appearance as it occurs in the one or the other place.

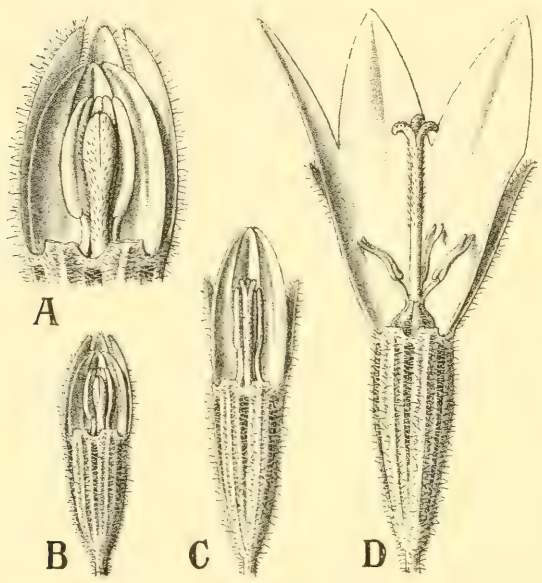


Fig. 18. *Campanula uniflora.*

The Pollination of Campanula uniflora. When in the young bud the anthers and the stigma are at the same level, the anthers begin to open, but the lobes of the stigma keep close together and their apices are bent inward toward each other Fig. 18 A, B). At this time no pollination can take place by the help of outward agencies, the corolla being closed. And as long as the anthers are at a higher level than the stigma, the former are quite closed and then the pistil with its sweeping hairs is also without pollen. But the style elongates rapidly in the yet closed flower and with its hairs sweeps off all the pollen from the open anthers (Fig. 18 C) so that its upper thicker part is everywhere coloured by the pollen. All the pollen is now to be found there, with the exception of a small portion which is left on the inner surface of the anthers. The flower opens simultaneously with the elongation of the style; but not until the pistil

has reached its full height do the anthers leave their hold of it and withdraw, doing so gradually as the corolla opens. And not until the latter is fully open (Fig. 18 D) are the anthers found reclining against its inner side. Now all the pollen is freely exposed and may be carried away by insect-visitors. Once only, on Kløftfjeldet, did I have abundant material of the plant in different stages of development, and there appeared to be only one means of pollination, viz. by the agency of insects; but I saw no such visitors. (Regarding the biology of the flowers see also Warming, 1886, in K. Danske Vidensk. Selsk. Oversigt, p. 152, fig. 13).

In November 1906 I planted three crocus-bulbs in a box in soil in which cress had been sown the autumn before; the cress, however, had withered when daylight disappeared and I had not paid proper attention to the plants. The soil had been obtained by crumbling various lumps of sod of presumably the best quality, judging from the plant-growth which had previously found nourishment in it.

When two of these bulbs began to shoot in the beginning of December it interested me to observe the development and growth of the plant as it necessarily was obliged to assume its form in a room without daylight, and with lamp-light for about 18 hours out of the 24.

On December 9 I had made a small mark with ink upon the scales of the bulbs just at the surface of the soil, and above this the two plants measured 39 and 28 mm. respectively. The third bulb had also germinated, but had not yet grown above the surface of the soil.

On December 11, at 10.20 p. m. the plants were measured again; their length had then reached 45 and 33 mm. respectively, the increase during 48 hours being 6 and 5 mm. respectively. In the course of 4—5 days the green leaves grew up outside the scales or basal leaves which were pale and membranous, but they were considerably elongated in length, as if etiolated. The plants were copiously watered with lukewarm water (22°). The respective heights were: —

On the 13th, in the morning 49—35 mm.
— — — , at 10.20 p. m. 51—37.5 —
— — 16th, - 1.15 a. m. 54.5—40 —

The third bulb then had four shoots, about 1 cm. above the surface of the soil. Several cress-seeds germinated owing to the copious supply of water, which benefited the whole.

The respective heights were: —

On the	16th,	at	9 a. m.	56.5—41.5	mm.
— —	— ,	-	11.45 p. m.	61 —45	—
— Dec.	17,	-	10 a. m.	63 —48.5	—
— —	18,	-	1 a. m.	64 —49.5	—
— —	—,	-	8.30 p. m.	65 —49.5	—
— —	19,	-	11.20 p. m.	70.5—54.5	—

Next the largest of the plants had one more shoot below. The third bulb elongated its four shoots very slowly, and the largest was then about 20 mm. above the surface of the soil, the others half as large.

The respective heights were: —

On Dec.	21,	at	12.30 a. m.	74—57	mm.
— —	—,	-	10 a. m.	75—59	mm.

Both were then marked afresh with Indian ink for further measurements. The box was turned round to find out whether the lamp-light attracted them: then there was a distinct bending inwards into the room and the light which came from it (the box stood upon the table before the window in the "Villa" on the land).

The respective heights were: —

On Dec.	22,	at	12.30 a. m.	77—60	mm.
— —	—,	-	1.10 p. m.	79.5—65.5	mm.
— —	23,	-	12.10 a. m.	81 —63	—

The cress since the noon of Dec. 22 had turned inwards into the room; perhaps the light there had attracted it, or else it avoided the lower temperature at the window and sought the warmth. Then the box was placed away from the window and upon the inner edge of the table, that towards the room, where it remained standing all through the night and the forenoon of the next day during which time it received light from the opposite side, from the lamps hanging over the table.

The respective heights were: —

On Dec.	23,	at	1.45 p. m.	82—63.5	mm.

The cress was then standing upright, bending most towards the side which had been illuminated during the forenoon. Then the box was again placed before the window.

The respective heights were: —

On Dec.	24,	at	3 a. m.	84.5— 64.5	mm.
— —	25,	-	1.30 a. m.	87 — 67	—

	On	Dec.	26,	at	12.5	p. m.	91.5— 71 mm.
	—	—	27,	-	12.40	a. m.	93 — 73 —
	—	—	—,	-	11.35	p. m.	96 — 75 —
	—	—	28,	-	11.35	a. m.	97.5— 76.5 —
	—	—	29,	-	1.15	a. m.	103 — 80.5 —
	—	—	—,	-	2	p. m.	106.5— 82.5 —
1907	On	Jan.	1,	at	12.45	p. m.	112.5— 87.5 mm.
	—	—	„	-	12	midnight	114 — 88.5 —
	—	—	2,	-	1.20	p. m.	115 — 90 —
	—	—	3,	-	12.30	a. m.	116.5— 91 —
	—	—	„	-	3	p. m.	120 — 94 —
	—	—	4,	-	1.40	a. m.	122.5— 95 —
	—	—	„	-	10.30	a. m.	123.5— 95.5 —
	—	—	5,	-	11.25	p. m.	127.5— 97 —
	—	—	6,	-	12.5	p. m.	130 —100.5 —
	—	—	7,	-	1.30	a. m.	133.5—101.5 —
	—	—	„	-	12.10	p. m.	136 —102 —
	—	—	8,	-	9.40	a. m.	140.5—105 —
	—	—	9,	-	2	a. m.	144.5—107.5 —
	—	—	„	-	11	a. m.	146 —108 —
	—	—	„	-	10	p. m.	149.5—110 —
	—	—	10,	-	10.30	a. m.	153 —111.5 —
	—	—	—,	-	11.30	p. m.	156.5—115 —
	—	—	11,	-	10.45	a. m.	160 —117 —
	—	—	12,	-	12.15	p. m.	167.5—120 —
	—	—	13,	-	12.45	a. m.	172 —124 —
	—	—	—,	-	12.10	p. m.	174 —124 —
	—	—	14,	-	11.10	a. m.	180 —126.5 —
	—	—	15,	-	1.40	a. m.	183 —129 —
	—	—	16,	-	1.40	a. m.	190 —135 —

Then the measurements were stopped. On February 12, when the higher of the plants had already for several days been showing a tendency to wither, it was dug up. It measured than 227 mm. and had a new corm just above the old one, of about the same size as the latter. This new corm was kept for some time in a dry place and was afterwards planted, but did not sprout.

On February 24 the second of the plants which had been measured had also withered; it had reached a height of 157 mm. The third crocus with its four shoots was fairly well-developed at the end of January; but all the shoots were very slender; the highest had attained 152 mm.

There was no evident difference between the colour of the leaves in December and in January and February although they were exposed to daylight at that time; the sun however was not as yet above the horizon. But it was difficult to decide whether any change of colour had taken place, as in February we had not the December growth for comparison; if there was any change it had come on imperceptibly from day to day.

5.—7.—1912.

V
VASKESTED
BASISKARET
IV
III
II
I
ASTR. OBS
MAGN. OBS
MAGN. S
DRAGEKASSER
LUFTELEKTR.
REGNMAALER
THERMOMETERSKUR
ANEMOMETER
VINDFLØI
VILLAEN
BAADE
Huggeblokken
N
VANDSTANDSMAALER
UDKIGSTØNDEN
(31 M.)
LABORATORIUM
BRANDVAAGE
SKIBET.
(1907-08)
(1906-07)
„DANMARK"s
VINTERKVARTER
1906-08.
0 20 40 60 80 100 120 140 160 180 200 Meter.
Højdetal i Meter.
Danmark-Ekspeditionen 1906/08
Lzd. F. Hemcelt, Kjøbhvn.

XIV.

ACARI.

BY

IVAR TRÄGÅRDH.

1912.

Introductory remarks.

Of the arctic countries Greenland is doubtless the one which has been most thoroughly explored with regard to its acarid fauna; the merit of this is chiefly due to the Danes who have brought together a very rich collection of Acari. Through the courtesy of Dr. MEINERT, the late director of the entomological department of the Museum of Natural History in Copenhagen, this collection was submitted to me and examined during my work on the monograph of the arctic mites.

Most of the localities on Greenland where mites were collected are, however, situated on the westcoast, from the southern point of the country as far north as to Tasiusak; on the eastcoast, on the contrary, only a few localities have been explored at Scoresby Sound, where RYDER's expedition made investigations in 1891 and a Swedish expedition under A. G. NATHORST in 1899.

As a consequence our information regarding the fauna of the eastcoast is much more meagre than of that of the westcoast and every addition to our knowledge of it is most welcome.

The following data illustrate our present knowledge of the acarid fauna of Greenland.

In my paper on the arctic Acari (12) 70 species of *Oribatidæ*, *Trombidiidæ*, *Parasitidæ*, *Hydrachnidæ* and *Tyroglyphinæ* were recorded from the arctic region, not taking the parasitic *Ixodidæ* and the *Analgesinæ* into consideration, nor the salt-water *Halacaridæ*.

Of these not less than 40 or 59 % were recorded from Greenland; but of these only 14 have been found on the eastcoast, whereas the westcoast has not less than 32 species. 9 species are common to both coasts, while 5 species from the eastcoast have not yet been recorded from the westcoast and 23 species known to occur on the westcoast have not yet been met with on the eastcoast.

Taking these circumstances into consideration it was with eagerness that I accepted the generous offer from Mr. F. JOHANSEN, the zoologist of the expedition, to examine and report on the collection of Acari made by him.

The collection consisted of 14 glass-tubes containing Acari from the following localities:

Koldewey-Islands 13th August 1906; 2nd camping-place 30. August 1906; Hvalrosodden 25th May 1907; Stormkap 18th, 22th and 25th June 1907; Thermometerfjældet near the harbour 24th August 1907; Seal-lake (no date); S. E. of Stormkap 19th June 1908; Maroussia 19th June 1908; a swamp between Rypefjældet and Hvalrosodden 4th and 5th July 1908.

SYSTEMATIC PART.

Fam. Parasitidæ.

Subfam. **Parasitinæ.**

Parasitus *Latr.*

P. fucorum (D. G.).

Of this species numerous nymphæ where found on *Bombus sp.* as well as in moss.

Localities: Stormkap, 18th, 21th and 22th June 1907; on *Bombus sp.* (two species) on the Thermometerfjæld near the harbour, 21th June 1907.

Distribution: East-Greenland (RYDER's expedition 1891); West-Greenland, Tigsaluk, on *Bombus sp.*, 8th September 1889; Holstenburg, on *Bombus sp.* 18th June 1890 (W. LUNDBECK).

The nymphæ have also been recorded from Italy, France, Netherlands and Sweden, from the southernmost part to the *regio alpina superior* of the Lappland mountains.

The adults were unknown until 1907, when they were discovered by the author in the nest of *Bombus kirbyellus* in the Sarek Mountains (13. p. 385).

The species has undoubtly a wide distribution and will probably, on further investigation, be found everywhere in the arctic and palæarctic region where there are humble-bees.

Subfam. **Lælaptinæ.**

Eulælaps *Berl.*

E. ambulans (Thor).

Locality: Numerous tritonymphæ femininæ generantes where found under loose stones lying on moist ground, Maroussia, 19th June 1908.

Distribution; This species is also widely distributed. It was discovered at Qanersoit, West-Greenland by the Swedish expedition and described by THORELL; subsequently it was found in Siberia by the Vegaexpedition and described by L. KOCH under the name *Gamasus ovalis;* later it was captured at Tasersuak 1890 (W. LUNDBECK), Røde Ø (RYDER's expedition) and on Iceland in 1892 (DEICHMANN) and in the Sarek Mountains by the author 1907, in the nest of a lemming.

The adults have not yet been discovered, only nymphæ generantes femininæ; but we may safely presume, in my opinion, that they will be found on the lemmings.

In 1910 I suggested that *Eulælaps stabularis* var. *proximus Berl.* found by SIG. THOR on a lemming in Norway was the female of *E. ambulans.* I have not had an opportunity of testing the truth of this suggestion, which the finding of nymphæ of the latter species in the nest of a lemming in the Sarek Moutains and the great similarity between *E. ambulans* and *E. stabularis* rendered very probable.

The measurements given by BERLESE (length 800) do not, however, agree with those of the specimens I have seen (length of nymphæ 900 and 1080 resp.), but the size of the species may vary in different localities.

Fam. Trombidiidæ.

Subfam. **Bdellinæ.**

Bdella *Latr.*

B. littoralis (L).

Localities: N. E. coast of Koldewey-Island 76° 20″ N. L. 13th August 1907, in the crevices of a desintegrated limestone-boulder, on the shore; on a sandy slope near the second camp 30th August 1907.

Distribution: Of all the Arctic acari *B. littoralis* is the one which is most widely distributed.

It occurs at the coast of France, England, Norway and Sweden; in the arctic region it is recorded from both West- and East-Greenland, Iceland, Jan Mayen, Bear Island, Nova Zembla, Siberia and Franz Joseph's Archipelago.

In the palæarctic regions it seems to be exclusively an inhabitant of the sea-shore, never to be found even at a short distance from it.

The field-notes of Mr. JOHANSEN seem to show, however, that in the arctic regions it is met with also at some distance from the shore. This is a very interesting observation which, combined with the fact that, contrary to the case in the palæarctic regions, there

are no other, large species of the genus in the same locality, seems to indicate that *B. littoralis* in places where there are no fellow-competitors may extend its hunting-ground inland.

Subfam. **Trombidiinæ.**

Podothrombium *Berl.*

P. bicolor (Herm.) var. **curtipalpe** SIG. THOR.

Locality: Stormkap, 22th June 1907, under a "knogel"? in a dry sandy place.

Distribution: West-Greenland, "between Sukkertoppen and Kangermiut", 5th June 1885 (S. HANSEN); Holstenburg, 13.—16. June and 8th July 1895 (W. LUNDBECK); Karsiliak near Navertalik, 22th May 1885 (T. EBERLEIN); Ritenbenk, 27th August (W. LUNDBECK); Iceland, Hekla-Harbour, April 1892 (DEICHMANN); Siberia, Arctic Lappland, Norway.

Notes on the colour: The colour of this var. was not known, all descriptions having been made on specimens preserved in spirit. The following statement regarding it was made by Mr. JOHANSEN: "Earth-mite, body blackish-red, with bright red legs and head" (the expression "head" obviously signifies the cephalothorax).

Fam. Hydrachnidæ.

Subfam. **Lebertiinæ.**

On **Hygrobates fabricii** Thorell.

THORELL (11. p. 150) identified with some doubt the specimen captured by J. LINDAHL at Qanersoit with the species recorded by FABRICIUS (*Acarus aquaticus*) from Greenland. He also gave a short description of a Hydrachnid larva found in the same locality on *Chironomus frigidus* ZETT and which he wrongly referred to *Trombidium*.

In my paper on the arctic Acari (13. p. 62—63). I suggested that this larva was the larva of *H. fabricii* which I considered as synonymous with *Lebertia vigintimaculata* S. T. recorded by SIG. THOR from Hammerfest and Senjen in Norway.

In a subsequent paper (7. p. 272—273) THOR expresses his doubts as to the synonymy of these two species, pointing out that THORELL expressly says that his species has no swimming-hairs on the legs. He furthermore repudiates my referring the larva figured by me to *L. fabricii* THOR. and even denies that it is a *Lebertia* at all, as it does not agree with the drawing of a larva of

that genus which PIERSIG has given in his great work "Deutschlands Hydrachniden".

He also points out that there is every reason to believe that Greenland harbours several species of Hydrachnidæ and that the negative evidence furnished by the researches made hitherto is not conclusive, no investigations having been made by experts on the group.

The discovery of a Hydrachnid by Mr. F. JOHANSEN rendered it imperative to reexamine THORELL's type specimen in order to settle definitely the questions mentioned above.

Owing to the extreme courtesy of Professor Y. SJÖSTEDT, the curator of the entomological department of the Government Museum in Stockholm, I was able to examine the type specimen of *L. fabricii* and to make a miscroscopical slide ot the legs and the gnathosoma.

Of THORELL's *Trombidium*-larva there is, on the other hand, no specimeu in the collections, so that we will never be able to learn what species it was.

The reexamination of *L. fabricii* with the aid of SIG. THOR's excellently illustrated and very detailed descriptions of all the well-known species of the genus *Lebertia* (7—10) has proved beyond doubt, that that is not the species found by the Danmark-Expedition on the N. E. coast of Greenland, but that there are two different species in Greenland, even belonging to different subgenera.

L. fabricii is a *Pseudoleberta* and according to SIG. THOR, who has been kind enough to examine the figures of the species which I sent to him, it is a distinct species, whether more closely related to the *glabra*-group or to the *maculosa*-group, however, he could not tell.

As to the larva figured by me in "Fauna arctica" and which I believed to be the larva of THORELL's species, SIG. THOR who has also examined this form is inclined to place it in the genus *Arrhenurus* or some closely allied genus.

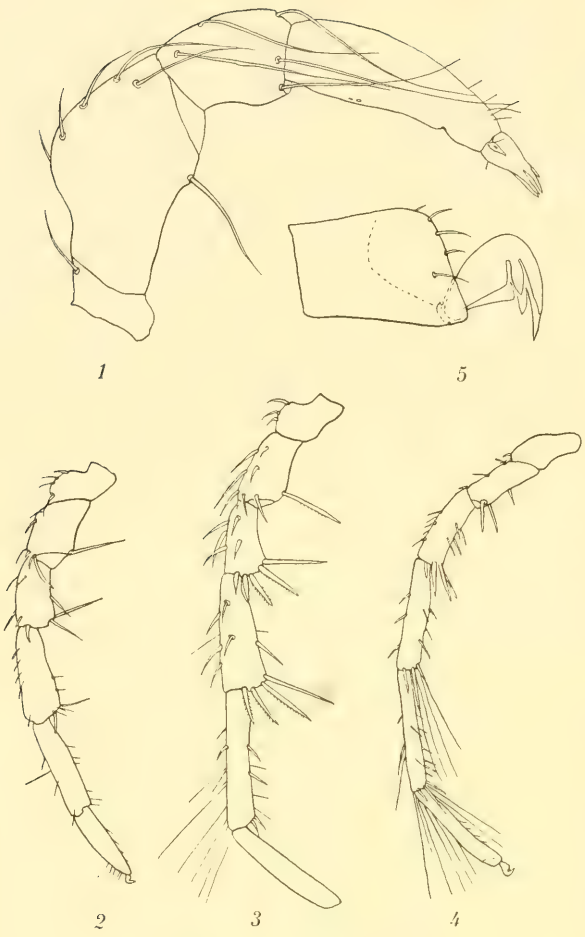
If this supposition is true, there are, consequently, still more hydrachnids in Greenland which the researches, hitherto made, have failed to discover.

Lebertia.

Subgen. *Pilolebertia* S. T.

P. porosa S. T.

Localities: Under the ice near the shore of a small freshwater-lake, near the "Bastion", Hvalrosodden, 25th May 1907; in a swamp between "Rypfjældet and "Hvalrosodden", 4th and 5th July 1908.



Lebertia (*P.*) *porosa* **S. T.**

Fig. 1. Maxillary palps, inner side view. × 295. Fig. 2. Leg I. × 50. Fig. 3. Leg II. × 50. Fig. 4. Leg IV. × 50. Fig. 5. Ambulacre of Leg IV. × 270.

Distribution: According to THOR (6. p. 779) this species in Norway is one of the most common forms in the lakes as well as the rivers. He also records it from the northern and southern Siberia and from Germany, Switzerland, Italy, France, England and Scotland.

This species JOHANSEN (5. p. 329) identified with *L. fabricii*, probably under the apprehension that only one Hydrachnid occurred in Greenland.

My determination of it has been verified by THOR. As he has given a detailed description of it with numerous drawings, it is not necessary to repeat this here. I therefore give only a few drawings of the organs, the characteristics of which are of the greatest value for identifying purpopes.

Fam. Oribatidæ.

Subfam. **Oribatinæ.**

Oribata *Latr.*

O. notata Thorell.

Locality: Under loose stones on moist ground, Maroussia 19. June 1908; several specimens.

Distribution: East-Greenland, Cape Stewart (RYDER's and NATHORST's expedition); FRANZ JOSEPH's Archipelago, Cape Flora, North-

brook-Island; Nova Sembla; Siberia; Spitzbergen; Jan Mayen; Bear Island; Arctic Lappland.

In 1910 BERLESE (3. p. 264) established a new species for an *Oribata* found by STRAND in Greenland (or perhaps found by somebody else, but belonging to STRAND's collection).

This species, named *Spærozetes strandi*, seems to be nothing else than *O. notata* Thor.[1]). Its diagnosis is as follows: "Badius, pyriformis, setis crassiusculis, longiusculus hirtus. Tecti lamellæ tantum usque in medio antico productæ, lata translamella intersese coniunctæ, apice acutæ, cæterumut in *S. setoso* conformatæ, Organa pseudostigmatica clavata. Genu et tibia primi et secundi paris seta robusta, spiniformi aucta. Ad. 700 long.; 400 lat."

Remarkably enough BERLESE does not compare it with *O. notata*; from the comparison with *O. setosa*, which the diagnosis contains, it is, however, evident that *S. strandi* differs from that species in exactly the same respects as does *O. notata*, viz. through the shorter cusps of the lamellæ and the presence of a stout bristle on genu and tibia of the 1st and 2nd pair of legs.

Fam. Sarcoptidæ.

Subfam. Tyroglyphinæ.

Tyroglyphus *Hering.*

T. fucorum Oudms.

Locality: Stormkap, 18th, 21st and 22nd June 1906, together with nymphnæ of *P. fucorum.*

Distribution: West-Greenland, Holstenburg, on *Bombus sp.*; Arctic Lappland, on *Bombus alpinus;* Netherlands.

[1]) It ought to be mentioned here that BERLESE during recent years has split up some of the old genera into a considerable number of new ones. As, however, only preliminary diagnosis of these have been published which in several instances are insufficient because not enough detailed, I consider it most appropriate to await the publishing of the definitive system before making any attempt to refer any of the species with which I am acquainted to BERLESE's new genera. His new genus *Sphærozetes* comprizes amongst others *Oribata setosa* and *O. notata.*

Remarks
on the composition of the acarid fauna of the region explored by the Danmark Expedition.

In all 7 species were discovered by Mr. JOHANSEN, which are distributed amongst the different families as follows: *Parasitidæ* 2, *Trombidiidæ* 2, *Hydrachnidæ* 1, *Oribatidæ* 1, *Sarcoptidæ* 1.

It is obvious that this collection is not exhaustive, and that further investigations will reveal several more species. Especially the *Oribatidæ* are undoubtedly far better represented than the present collection seems to indicate. As is well known the main part of the species belonging to this group are fungivorous or lichenivorous; as a consequence, they are able to find shelter and means of subsistence wherever lichens and fungi are to be found, whereas the carnivorous *Parasitidæ* and *Trombidiinæ* are dependent on the occurrence of other small arthropods, partly *Collembola* and *Thysanura,* partly other mites as well as larvæ of insects.

The fundamental difference as regards the food of the groups greatly influences their geographical distribution.

In a paper on the Acari of Sarek-tjåkko (1911) the author investigated amongst other things this problem and proved that, while of the *Oribatidæ* 42.1 % ascended to the regio alpina superior, only 17 % of the *Parasitidæ* went as high.

If we compare the actual number of both groups the difference between them becomes still more evident, only 4 *Parasitidæ* being recorded from the regio alpina superior against 16 species of *Oribatidæ.*

There is no reason why the numerical proportion of these two groups should not be about the same in East-Greenland as in the above mentioned part of Sarek-tjåkko, and consequently we are, in my opinion, justified in assuming its fauna to be considerably richer in *Oribatidæ;* the same also probably applies in some degree to the *Trombidiidæ.*

All the terrestial mites now recorded are widely distributed forms which occur in many parts of the arctic region, and some of which are also to be found in the palæarctic region.

Three of them, *Eulælaps ambulans*, *Parasitus fucorum* and *Tyroglyphus fucorum* doubtless owe their wide distribution to their biological relations to other animals, the lemming and the humble-bees and it is of great interest to notice that the two former are the only *Parasitidæ* yet found on the East-coast of Greenland.

As to *Bdella littoralis* it is a strictly littoral form which or the eggs of which are apt to be dispersed by means of driftwood etc.

Podothrombium bicolor var. *curtipalpe,* on the other hand, is more particular; contrary to *Bdella,* the larvæ of which are free-living like the adults, its larva is ectoparasitic and dependent on other arthropods (spiders or insects); its geographical distribution consequently becomes restricted to the places where suitable hosts occur. This is, as pointed out by the author (13. p. 573), the most probable explanation of the fact that no *Trombidiidæ* or *Erythræinæ*, the larvæ of which are all ectoparasitic, have been found on small, isolated islands, as for instance Bear Island and Jan Mayen or in the regio alpina superior of the mountains of arctic Lappland.

Comparison with the fauna of the neighbourhood of Scoresby Sound.

As above mentioned the only other place on the East-coast of Greenland at which the acarid fauna has been explored is Scoresby Sound. From this place the following 14 species have been recorded:

Oribatidæ: Oribata notata Thor., *Tectocepheus velatus* Mich., *Nothrus horridus* Herm. var. *borealis* (Thor), *Notaspis exilis* Nic. var. *crassipes* (L. Koch). *Hermannia reticulata* Thor.

Trombidiidæ: *Penthaleus insulanus* Thor., *P. hæmatopus* Can., *Bdella littoralis* (L.), *Bryobia prætiosa* K., *Podothrombium bicolor* (Herm.) var. *curtipalpe* Sig Thor, *Erythræus phalangioides* (D. G.) var. *gracilipes* (Kram.), *Rhyncholophus miniatus* (Herm.).

Parasitidæ: Eulælaps ambulans Thor, *Parasitus fucorum* (D. G.).

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9.—8.—1912.

XV.

A MARINE DORYLAIMUS FROM GREENLAND WATERS, DORYLAIMUS MARITIMUS, N. SP.

BY

HJALMAR DITLEVSEN

1913

In some bottom material from the "Stormbugt" Dr. BREHM who dealt with the Entomostraca brought home by the "Danmark-Expedition" found several Nematodes which he was kind enough to take out and forward to our Museum. The examination gave the result that all the Nematodes belonged to the same species and that it was a Dorylaimus.

Of this genus, exceedingly frequent among the land- and freshwater forms, only one marine species has been described so far as I know, namely a Dorylaimus found by DUJARDIN at Lorient and described in his "Histoire naturelle des Helminthes ou vers intestinaux, Paris 1845", under the name of Dorylaimus marinus. That the genus however has been taken later in the sea is evident from the Annual report of the Liverpool Marine biology committee by W. A. HERDMANN for the year 1912, where among several other marine genera gathered by himself GILBERT E. JOHNSON also names the Genus Dorylaimus. As this is only a list of the genera the question of species is not at all mentioned.

As the material from Greenland proved to be in a rather bad state of preservation I picked out some specimens which appeared to be tolerably open to examination, four in all, females. No males were found in the material.

It soon proved that the species present could not be identical with the Dorylaimus marinus of DUJARDIN who describes the tail of the named species as: "longue, effilée", while the tail of the species from Greenland is rather short and hook-shaped. The spear of the species from Lorient does not seem to have the usual quill-shape (DUJ. l. c. Pl. 3 fig. D 1.) while the spear of the specimen from the Danmark Expedition just has this form. Only one thing more I shall mention: the relation between the length and the breadth is for the species of DUJARDIN 24, for the Greenland specimen $37^1/_2$.

What first was striking in the Greenland specimens was their lack of transparency and their dark olive-green colour. The body is slender and tapers rather quickly towards the front end and

the tail. The greatest thickness is measured near the vulva, a little before the middle of the animal. The front end is marked by a rather sharp constriction. The mouth is surrounded by 6 prominent, nearly globular lips devoid of papillæ. The tail is tolerably short, conical with hook-shaped tip. This hook-shaped tip is present in all the specimens even when the whole body for the rest is stretched out. The spear of the mouth is strong, measures c. 17 μ in length and is of the well-known, usual quill-shape with its apex obliquely cut off.

The oesophagus, the length of which measures between $^1/_5$ and $^1/_6$ of the length of the whole animal, has its greatest thickness in its proximal end and tapers evenly towards the front end of the animal. The nerve-ring is seen on the limit between the first and second third of the oesophagus.

The intestine has its hindmost part differentiated in the same way as usually occurs in this genus and is seen under high magnifying powers to contain dark refractive granules.

The reproductive organs stretch only slightly forward and backward in the animal. The down-bent terminations of the ovaries pass each other with their tips respectively from behind and from before exactly over the vulva (see fig. 1). Only one of the individuals had ripe eggs; they are found to the number of two, one before and one behind the vulva and are rather thick-shelled. They measure 82 μ in length and 32 μ in breadth.

Finally I shall only point out, that while the Dorylaimus marinus Dujardin must be arranged in the group ε of de Man to which belong Dorylaimus stagnalis, brigdammensis and others, the species here dealt with must be arranged under the group γ for which D. Carteri is the main type[1].

Measurement of adult female with shell-eggs:

Length	2·46	mm.
Breadth	0·007	—
Vulva	1·18	—
Oesophagus	0·04	—
Tail	0.01	—

[1] De Man: Die frei in der reinen Erde und im süssen Wasser lebenden Nematoden d. Niederl. Fauna. Leiden 1884.

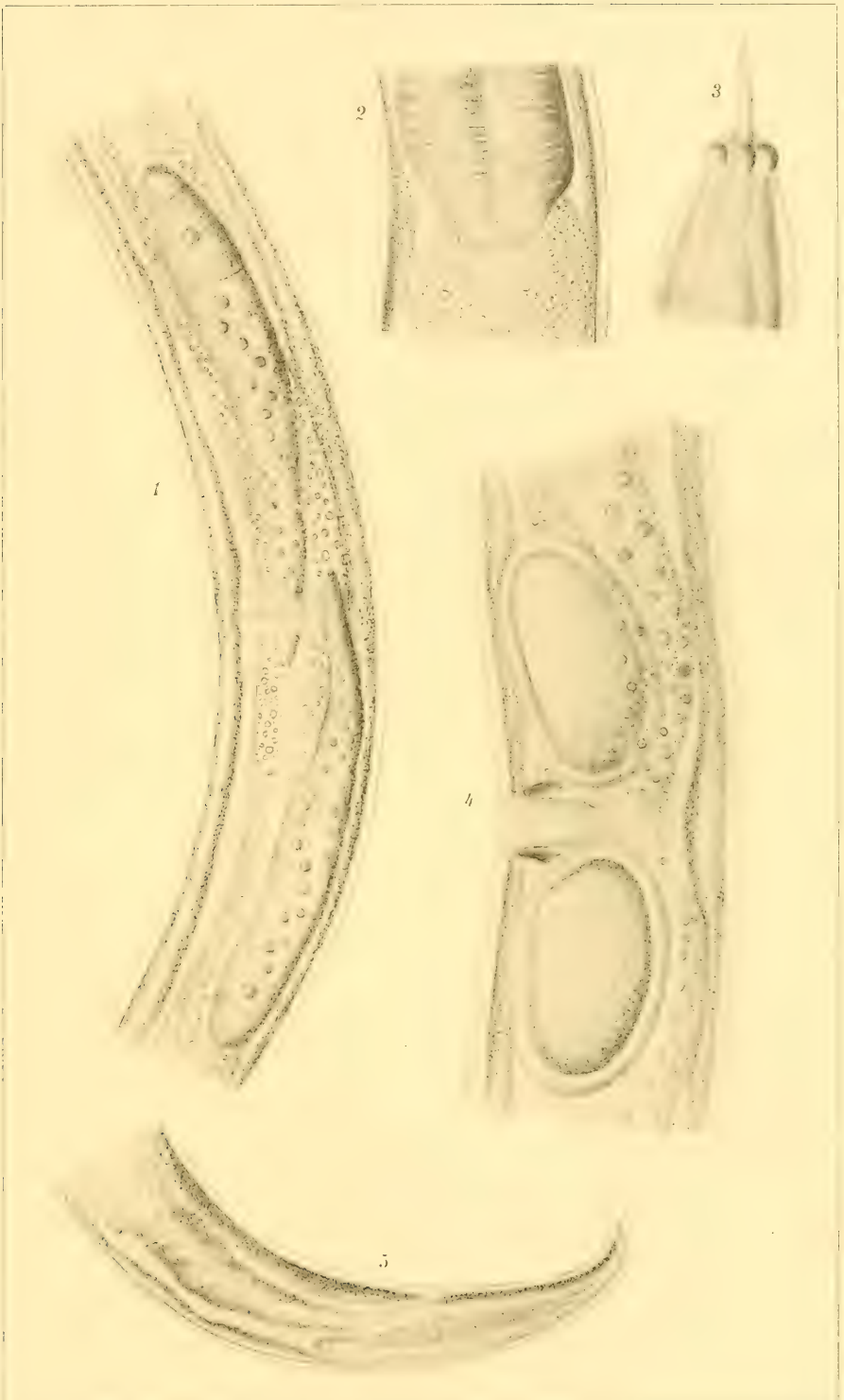
PLATE XVIII.

PLATE XVIII.

Zeiss' microscope was used.

Dorylaimus maritimus n. sp.

Fig. 1. Young female. Reproductive organs. Apochr. 8 mm. Comp. 4.
— 2. The limit between the Oesophagus and the Intestine. Obj. E. Oc. 2.
— 3. The front end of the animal, showing the lips and the spear. Apochr. 2 mm. Comp. 4.
— 4. Vulva and shell-eggs of a full-grown female. Apochr. 3 mm. Comp. 4.
— 5. Hind part of a specimen, showing the differentiated part of the intestine and the hook-shaped tail. Obj. DD. Oc. 2.



Autor del. *Pacht & Crone phototyp.*

XVI.

BRYOZOA

BY

G. M. R. LEVINSEN

PREFACE.

Among the unpublished works left by my late predecessor, G. M. R. Levinsen was found a manuscript on the bryozoa collected by the Danmark Expedition at the north-east coast of Greenland. Of this manuscript there is a fair copy of only the smaller portion, while of the latter and greater part only a rough copy exists. Moreover 6 plates for this paper, engraved in copper and already printed, were found.

As the committee for the publication of the scientific results of the Danmark Expedition, after having defrayed the expense of printing the 6 mentioned plates, greatly wished to get Levinsen's paper printed, I agreed to offer my co-operation. From the rough copies I gathered, as far as possible, a complete manuscript, and I took great pains to interpret Levinsen's handwriting correctly, which, during the latter years of his life, had become somewhat illegible.

Extremely valuable assistance was rendered me by the well-known Norwegian Zoologist Dr. O. Nordgaard of Trondhjem, who, at my request, kindly undertook to read the 2nd proof of the paper, whereby he solved various questions as to which I was in doubt. But where Dr. Nordgaard's assistance has been of the greatest importance is in his preparation of an explanation of the plates which was entirely lacking from Levinsen's hand, only the name of the species being given on the original drawings, while nothing was said as to what the drawings were meant to illustrate. In this way the explanation of the 6 plates is entirely due to Dr. Nordgaard, and thanks to his competent assistance access to an understanding of Levinsen's excellent drawings is also possible. — For all good help in this matter I hereby offer Dr. Nordgaard my sincere thanks.

It is easy to see that the paper now before us is unfinished; thus, in the text, mention of the species illustrated on Pl. XXIV is entirely wanting. But its usefulness and value is guaranteed

by Dr. NORDGAARD's appreciation when, after having looked through the work, he wrote to me: "I can say with safety that it would have been a great pity if LEVINSEN's posthumous manuscript had not been printed." And with this remark of the distinguished specialist in the bryozoa I deliver LEVINSEN's work to the public, feeling convinced that the late author will not be held responsible for its deficiencies, as he had no opportunity either to complete it or to subject it to a last revision.

Copenhagen, May 20. 1916.

AD. S. JENSEN,
Director of the 2nd Division of the Zoological Museum
of the University.

Ordo Cheilostomata.

Subordo Anasca.

Fam. *Bicellariellidae.*

Dendrobeania Murrayana Johnston.

Flustra Murrayana Johnston, British Zoophytes, sec. ed., p. 347, pl. 63, figs. 5, 6.

Bugula Murrayana Smitt, Krit. Förteckn. öfver Skand. Hafs-Bryozoer (Öfvers. K. Vet.-Akad. Förh. 1867, N. 5, pp. 291—92, pp. 348—53, Tab. XVIII, figs. 19—27).

Menipea fruticosa Packard, Invertebrate Fauna of Labrador and Maine (Boston Soc. of Nat. Hist. vol. 1, 1866—69, p. 273).

Bugula Murrayana Levinsen, Bryozoer fra Kara-Havet (Dijmphna-Togtets zoolog.-botan. Udbytte, 1886, pp. 310—12, Tab. XXVI, figs. 3—6).

— — Bidenkap, Bryozoen von Ost-Spitzbergen (Zoolog. Jahrbücher, Abth. f. Systematik, 1897, p. 615).

— — Waters, Bryozoa from Franz-Josef Land (Journ. Linn. Soc., Zool., vol. 28, pp. 52—54).

Brettia frigida Waters, eodem loco p. 51, pl. 7, figs. 1—3.

Brettia minima Waters eod. loco, p. 52, pl. 7, figs. 5—7.

Bugula elongata Nordgaard, Die Bryozoen d. westlichen Norwegens (Meeresfauna von Bergen), Bergen 1906, p. 80, Taf. I, figs. 1—6.

Bugula quadridentata Andersson, Zool. Jahrbücher, Abth. f. Systematik, 1902, pp. 537—38.

Bugulopsis Peachii Norman, Notes on the nat. hist. of East Finmark (Annals Nat. Hist. sér. 7, vol. 11, 1903, page 577).

Bugula elongata Norman, Notes on .... Corrigenda (Annals Nat. Hist., ser. 7, vol. 15, 1905, pages 358—59).

Dendrobeania murrayana Levinsen, Morph. and system. studies on the Cheilostomatous Bryozoa, 1909, pages 99, 113.

— — Nordgaard, Revision av Norske Bryozoer (K. Norske Vid. Selsk. Skrifter, 1911, NR 3, p. 17).

I have only seen a number of small colonies fixed to algae. The zooecia are arranged in 2—9 longitudinal series and are provided with 1—5 spines on each side. They belong to the varieties *fruticosa* and *quadridentata*.

Station 63, Stormbugt, 10—20 m.

Station 72, Stormbugt, 10—15 m.

Gemellaria loricata L.

Fistulana ramosa Fabricius, Fauna Groenl., p. 441.

Cellularia loriculata Fabricius, Nye Zool. Bidrag, K. Danske Vid. Selsk. nat. og math. Afh. 1. Del, 1824, p. 31.

Gemellaria loricata Smitt, op. cit. 1867, pp. 286 og 324, pl. 17, fig. 54.

— — Hincks, Br. M. Polyzoa, p. 18, pl. 3, figs. 1—4.

— — Levinsen, Mosdyr, p. 41, Tab. I, figs. 1—3.

Of this species I have only seen the remnants of 5 small colonies each consisting of 1—5 pairs of zooecia fixed to cirri of *Antedon prolixa*.

Station 99, 77° N. 18½° W., 304 m.

Fam. *Scrupocellariidae*.

Scrupocellaria scabra v. Ben.

Sertularia halecina Fabricius, Fauna Groenl. p. 443.

Flustra scruposa Fabricius, Nye Zool. Bidrag, K. Danske Vid. Selsk. Nat. og Math. Afh. 1821, 1 D., p. 33.

Cellularia scabra Smitt, op. cit. 1867, pp. 283 og 314, Tab. XVII, figs. 27—36.

Scrupocellaria scabra Hincks, op. cit. p. 48, Pl. VI, figs. 7—11.

— — Levinsen, Mosdyr, p. 44, Tab. I, figs. 19—25.

— — Waters, Journ. Linn. Soc., Zool., Vol. XXVIII, p. 54, pl. 7, figs. 14—16.

(Pl. XIX, fig. 1).

In the colonies examined the distal wall is (besides the large somewhat semilunaire or angularly bent collection of uniporous rosette-plates found in almost all the members of this family) provided with one, two or rarely three rounded, but otherwise differently shaped pore-chambers of rather different size. Each of them is provided with a single uniporous rosette-plate, rarely with a few. As a rule they are present in all the zooecia. I have not seen such pore-chambers in colonies from Denmark or from West-Greenland, but I have found similar structures in *Menipea roborata* Hincks and *Men. ligulata* M'Gill.[1]

[1] Levinsen, Morph. and Syst. Studies on the Cheil. Bryozoa, pp. 138—141, pl. 2.

A number of small colonies fixed to algae.
Station 63, Stormbugt, 20—40 m.
Station 72, Danmarks Havn, 10—15 m.

Scrupocellaria ternata Ellis & Sol. var. **gracilis** Smitt.

Cellarina gracilis Van Ben., Bull. Acad. Roy. Belgique XV, p. 70, Pl. X, figs. 1, 2.
Cellularia ternata, forma gracilis Smitt, op. cit. 1867, pp. 283 and 308, Tab. XVI, figs. 14—24.
Menipea arctica Ridley, Annals Nat. Hist, S. V., Vol. VII p. 444.
— *gracilis* Busk, Journ. Linn. Soc., Zool., Vol. XV, p. 232.
Scrupocellaria ternata, var. gracilis Waters, Journ. Linn. Soc., Zool., p. 55, Pl. VII, fig. 12.
(Pl. XIX, figs. 2, 3).

As I have pointed out in my work on the Cheilostomatous Bryozoa (pag. 132, foot-note) this species possesses a vibraculum[1] which differs from the other vibracula found in this family in the lack of a flabellum, whereas the distal end is provided with a round aperture covered by a membrane. Like the other vibracula in this family it is divided into two compartments by a wall provided with a rosette-plate (fig. 2), and a radical fibre may take its origin from an aperture in the proximal compartment. By means of reagents it may be isolated from the zooecium, being provided with an inner wall of its own.

A few small fragments from Station 63, Stormbugt, 20—40 m.

Bugulopsis Peachii (Busk).

Cellularia Peachii Smitt, op. cit. 1867, pp. 285, 322, Tab. XVII, figs. 51—53.
— — Hincks, op. cit. p. 34, Pl. V, figs. 2—5.
Scrupocellaria Peachii Waters, Journ. Linn. Soc., Zool., Vol. XXVIII, p. 58.
Bugulopsis Peachii Verrill, Amer. Journ. Science and Arts, Vol. XVIII, pp. 52—54.
Cellularia Peachii Osburn, Bull. Bur. Fish., Vol. XXX, p. 223, Pl. XXI, fig. 20 bis.
Bugulopsis Peachii Nordgaard, Bryozoaires, p. 7. Duc d'Orleans, Campagne arctique de 1907.

[1] This rudimentary vibraculum has been figured by Smitt, who in the explanation of pl. 16 mentions it in the following way: "The upper part of this swelling corresponds to the vibraculum which in the following species is found in this place".

In most zooecia of the small fragment the distal wall is provided with a small rounded pore-chamber of the same structure as those found in *Scrup. scabra*. I have not seen such a pore-chamber in specimens from other localities.

Station 95 a. The Sound between Renskæret og Maatten, 50—100 m.

Fam. *Membraniporidae.*

Membranipora (Electra) catenularia Jameson.

Flustra membranacea O. F. Müller, Prodromus Zool. Danicae, p. 253.
— — Abildgaard, O. F. Müller, Zool. Danica, vol. 3, p. 63, tab. 117, figs. 1, 2.
Tubipora catenularia Jameson, Wernerian Mem. p. 561.
Membranipora pilosa, forma catenularia (*M. catenularia*) Smitt, op. cit. 1867, pp. 370, 417, pl. 20, figs. 45—38.
Membranipora catenularia Hincks, British Marine Polyzoa, p. 134, pl. 17, figs. 1—2.
— *monostachys* var. a (*fossaria*) Hincks, eod. loco, p. 132, pl. 18, figs. 3, 4.
— *tenella* Hincks, A General Hist. of the Marine Polyzoa (Annals Nat. Hist. 5. ser., vol. 6, 1880, p. 376, pl. 16, fig. 7).
— *catenularia* Levinsen, Mosdyr, Zool. Danica, 4. B. 1. Afd., 1894, p. 56, Tab. III, figs. 37, 41.
— *monostachys* Waters, op. cit. 1900, p. 59, pl. 8, fig. 3.
— *Mülleri* Bidenkap, Die Bryozoen, Fauna arctica, 1 Cheil. 1900, p. 532, Tab. IX, fig. 1.
— — Norman, Notes on the Nat. Hist. of East Finmark (Annals Nat. Hist. ser. 7, vol. 11, 1903, p. 586, note.

This species is one of the only three species of cheilostomatous Bryozoa in which a calcareous operculum has hitherto been found. It is interesting, moreover, in being the only Bryozoon found in the innermost part of the Baltic, while at the same time it is widely spread in the arctic seas. While at Spitzbergen it lives in a depth of 9—20 fath., it has been found in the boreal sea outside of Norway in a depth of 200—300 fath.; and at Copenhagen I have found it in the "Stadsgraven and the Kalvebodstrand" in water of a very small degree of salinity and in a depth of less than one foot. Smitt has already pointed out that the baltic form of this species must doubtless be regarded as a relict.

We may discern two varieties, namely the var. *fossaria* in which

the frontal area is wholly membranous, and the var. *catenularia* in which the membranous area is greatly reduced. The latter, which is widely spread in the arctic seas, often forms a more or less irregular dendritic pattern.

A single colony of the var. *catenularia* on a stone.

Station 63. Stormbugt, 20—40 m.

Membranipora (Callopora) craticula Alder

Membranipora lineata 1, *forma craticula* Smitt, op. cit. 1867, pp. 363—64, pp. 390—93.
— *craticula* Hincks, Brit. Marine Polyzoa, p. 147, pl. 19, fig. 7.
— — Levinsen, Mosdyr, op. cit. p. 60, Tab. V, figs. 4—6.
Callopora — Norman, op. cit. 1903, p. 589, pl. 13, fig. 3.
Membranipora craticula Osburn, Bryozoa of Woods Hole Region (Bull. Bureau Fisheries, vol. 30, 1910, p. 229, pl. 23, figs. 32, 32 a, 32 b).

(Pl. XIX, figs. 4, 5, 6, 7).

In my paper on the Danish Bryozoa (Mosdyr) I have pointed out that in this species an independent avicularium appears which has been figured, but not mentioned, by Hincks. These avicularia are most conspicuous in the free margin of the colony; especially when we regard a young disciform colony, we find them in the whole circumference of the latter, placed in a number of 1—7 alongside each other, each such series being separated from the next one by a various number of zooecia. We may discern two different sizes, large ones, in which the avicularian beak is surrounded by a broad, somewhat convex area (fig. 4) and small ones from which the ooecium belonging to a subjacent zooecium is formed (fig. 6). Such a small avicularium is easily discerned from a superficial or independent one seated on an ooecium, in that that it does not rise from the top of the ooecium, but is only placed distally to the latter, and when a colony is regarded from the basal surface it is easily recognised by means of its small independent chamber provided with a vertical distal wall and with pore-chambers.

In the colonies examined the length of the zooecia varies. The membranous area is surrounded by 14—19 somewhat flattened acuminate spines. Besides the well-known avicularium placed proximally to the membranous area (in zooecia with ooecia seated on the top of the latter) there is mostly, in a various number of zooecia, found one or two small lateral avicularia with the mandible directed

outwards and placed, as a rule, on a level with the first third of the membranous area.

In a colony from St. 63 a fairly large number of zooecia have the frontal area more or less filled by a somewhat convex calcareous film, perforated by an oval opening of different size, while in other zooecia the central portion of the film is occupied by an avicularian beak. We have, therefore, no doubt to do with a regeneration, by which an avicularium has been formed within an old zooecium. A number of regenerated zooecia has also been found.

A number of colonies from Stat. 63, Stormbugt, 20—40 m.
Stat. 68, off Cape Bismarck, 40—60 m.
Stat. 71, off Cape Bismarck, 30—40 m.
Stat. 72, Stormbugt, 30 m.

Membranipora (Callopora) lineata L.

Flustra lineata Fabricius, Fauna Groenl., p. 137.
Eschara — Fabricius, Manusk. Hefte 3, Nr. 384.
Membranipora lineata 2, *forma lineata* Smitt, op. cit. 1867, pp. 364 and 390, Tab. XX, fig. 23.
— — Hincks, British Marine Polyzoa, p. 143, pl. 19, figs. 3—6.
— — Levinsen, Mosdyr, Zoologia Danica, 4 B, 1. Afd., p. 60, tab. 5, figs. 4—6.
— — Osburn, op. cit. p. 228, pl. 23, figs. 31—31 c.

I have not been able to find independent avicularia in any of the colonies of this species which I have hitherto examined.

A rather small number of colonies mostly on hydroids, on the stems and branches of which they form narrow cylindrical incrustations.

Stat. 62, Stormbugt, 10—20 m.
Stat. 66, Stormbugt, 30—40 m.
Stat. 67, Danmarks Havn, 20—30 m.
Stat. 68, off Cape Bismarck, 40—60 m.

Membranipora (Callopora) arctica d'Orb.

Reptoflustrina arctica d'Orbigny, Paléontologie Française Terr. Cret., T. 5, Bryozoaires, p. 582.
Membranipora Sophiae Busk, Zoophytologie, Quart. Journ. Micr. Sc., vol. 3, p. 255, pl. 1, fig. 7.
— *lineata, forma Sophiae* Smitt, op. cit. 1867, pp. 365 and 394, pl. 20, figs. 24, 25.

Membranipora arctica v. Lorenz, Bryozoen von Jan Mayen (Die internationale Polarforschung 1882—83, 3 B.), p. 3, Taf. 7, fig. 1.
— — Waters, Journ. Linn. Soc. Zoology, p. 60.
— — Osburn, Bulletin Bureau of Fisheries, vol. 30, p. 229, pl. 23, figs. 33—34, pl. 30, fig. 86.
Callopora Sophiæ Norman, Annals Nat. Hist., Ser. 7, Vol. XI, p. 590.

A number of small colonies from algae and stones.
Stat. 63, Stormbugt, 20—40 m.
Stat. 66, Stormbugt, 30—40 m.
Stat. 71, off Cape Bismarck, 30—40 m.
Stat. 72, Stormbugt, 30 m.

Membranipora (Callopora) trifolium S. Wood.

Membranipora Flemingii, forma trifolium Smitt, op. cit. 1867, pp. 367 and 405, Tab. XX, figg. 37—42.
— *trifolium* Hincks, op. cit. p. 167, Pl. XXII, figs. 5, 6.
Amphiblestrum — Norman, Annals Nat. Hist., Ser. 7, Vol. XI, p. 597, Pl. XIII, fig. 6.

Two colonies of the variety *quadrata*. In one of them, of which there are only a few zooecia left, is seen an ancestrula with a highly convex frontal surface, in the distal half of which is seen a circle of 10 spine-marks, surrounding not only a very small opening provided with a concave proximal margin, but also a descending cryptocyst of a similar size.

St. 71 a, Stormbugt, 30—40 m.
St. 15, Lat. 76° 35′ N. Long 18° 26′ W., 150 m.

Membranipora (Callopora) spathulifera Smitt.

Lepralia spathulifera Smitt, op. cit. 1867, Bihang, pp. 20 & 124, pl. XXVI, figs. 94—98.
Microporella — Waters, op. cit. p. 87, pl. 12, fig. 6.
Doryporella — Norman, Annals Nat. Hist. 7. S., Vol. XII, 1903, p. 106.
Callopora — Levinsen, Cheilost. Bryozoa 1909, p. 151.
Lepralia — Osburn, Proc. U. S. Nat. Museum, vol. 43, 1913, p. 282, Pl. XXXIV, figs. 2, 2 a and 2 b.
(Pl. XIX, figs. 8, 9, 10).

By the earlier authors this interesting species has been referred to three different genera of the division for which I have proposed the name *Ascophora*; but in my work on the cheilostomatous Bryozoa

I have pointed out that it really belongs to the family *Membraniporidæ* and especially to the subgenus *Callopora*. Smitt, the author of the species, refers it to *Lepralia* because the aperture in the colonies examined by him has a certain likeness to that of *Lepralia Pallasiana* being provided with a short proximal enlargement, and this fact distinctly shows how little the form of the aperture is to be relied upon as a systematic character. The form and the size of the aperture in this species is really subject to a very great variation, and while in some colonies, f. inst. in those examined by Smitt, the length of the aperture is contained thrice in that of the whole zooecium, in others (pl. XIX, fig. 9) it is half as long as the latter and has an ovate-pyriform shape. It is evident that we have here to do with a membranous frontal area, provided with an opercular valve. We may further point out two other characters which distinguish the members of the division *Anaska*, namely that the avicularia lack a cross-bar, and that the frontal calcareous surface has no pores.

None designates the zooecia as punctate, but in all the colonies examined by me the whole surface of the zooecia and of the ooecia is provided with an elevated reticulate meshwork. The distal portion of the aperture is surrounded by 4—6 spines, the two distal ones being separated by a large interspace; the two proximal ones are often absent. In most colonies examined by me the spines are represented by a cylindrical open joint, but sometimes there are two or three, and in some colonies the base joint of the second pair has a more or less broad, flattened form, reminding one of the singular spatulate spine seated proximally to the aperture. In a single colony the two distal pairs of spines are very long, bifurcate.

The median avicularium, which has been seen already by Smitt but not recognised by Waters and Norman, corresponds to that found in the same place in other species of the subgenus *Callopora*, and the lateral avicularia correspond to those which I have found in *M. craticula*. For the rest they are all very inconstant. When the median avicularium is found together with an ooecium it is partially or wholly placed on the top of the latter but I have seen a whole colony with many ooecia and not a few avicularia in which not a single avicularium is in connection with an ooecium. The ectooecium is undoubtedly membranous. The distal half of each zooecium is provided with 6 large, few-pored pore-chambers, two distal ones and two on each side.

8 small colonies, 6 of which are found on stones.

St. 63, Stormbugt, 20—40 m.

St. 71 a, off Cape Bismarck, 30—40 m.

Membranipora (Callopora) Whiteavesi Norman.

Callopora Whiteavesii Norman, Nat. Hist. of East Finmark, Polyzoa (Annals Nat. Hist. 7. S., Vol. XI, 1903), p. 589—90, Pl. XIII, fig. 9.

Membranipora lineata, forma lineata part. Smitt, Op. cit. 1867, Pl. XX, fig. 26.

(Pl. XIX, figs. 11, 12, 13, 14).

The specimens examined differ somewhat from those described by Norman, and may perhaps be regarded as belonging to a distinct variety.

The zooecia are irregularly arranged and the large frontal area is ovate or pearshaped-ovate. It is provided with a well-developed granular cryptocyst and surrounded by 14—20 very long spines curved sligthly inwards at their proximal part; the spines are as a rule fixed in small sinuations of the cryptocyst and slope slightly inwards. They are of very different size, and as a rule the thicker ones are seated in the distal curve of the zooecium, but while in some cases their thickness declines distinctly towards the proximal end, in other zooecia the difference is not so very large. Sometimes, also, one or more very thin ones may appear among much thicker ones. Besides those immediately surrounding the cryptocyst there appear as a rule in the distal half of the zooecium 5—10 spines placed outside the others at a different height, and sometimes a number of them are seated halfway down the wall. These outer spines are very often very slender. As the cryptocyst has a very variable breadth in different places this circumstance together with the presence of the above mentioned extraordinary spines produces the impression that the spines are more or less irregularly arranged. In a number of colonies from Egedesminde the spines are very much shorter and more are found outside the others.

I have only seen a single ooecium with an undamaged frontal wall; the latter is densely granular but without other impressions or projections. In the colonies from Egedesminde the ooecium is much larger (its length being contained $1^1/_2$—2 times in the length of the membranous area) and more elongate, and its proximal portion is provided with a low but broad triangular area. Distally to this area is seen a strong, narrow vertical projection, the surface of which is uneven or irregularly nodulous. It seems to have been formed originally by two lateral halves, representing the thickened margins of the two halves of the calcified ectocyst, which grow together in the median line. It corresponds therefore to the transverse

or angularly bent rib found in a number of the *Callopora*-species, but it has nothing to do with the first pair of ribs as suggested by Norman. Between the two calcareous layers of the ooecium is seen a reticulate net-work of wavy channels, and a similar net-work is also seen f. inst. in *Membr. aurita.* In the meshes between the channels the two calcareous layers are coalesced with each other.

Each zooecium is provided with 5 widely separated pore-chambers, one distal and two lateral on each side.

In a number of zooecia I have found the aperture partially filled by a calcareous plate, which is perforated in the middle by an ovate opening. In this plate we may discern between an outer smooth portion and an inner broad belt surrounding the opening and provided with a net-work of fine undulated lines. In a number of cases the boundary between this belt and the outer smooth portion is marked by 5—6 pores, undoubtedly representing as many spines. In one case only a proximal pore is present and in a few cases there are no pores. There can be no doubt that this inner belt is the cryptocyst of a regenerated zooecium, and it is evidently such a case which Norman mentions when he says that the membranous frontal wall "is not destroyed by liquor potassæ, and thus it would appear that the strengthening material is calcareous." In one of the zooecia which have been regenerated a portion of the wall of the old zooecium has been removed to the very basal surface and the corresponding portion of the wall of the new zooecium is distinctly seen. An inspection from the basal surface shows, further, that the basal outlines of the two zooecia are a little different.

A few colonies on stones.

St. 15, Lat. 76°35′ N. Long. 18°26′ W. 150 m.

St. 72, Danmarks Havn, 10—15 m.

Membranipora (Callopora) unicornis Fleming, var. **armifera** Hincks.

Membranipora lineata, forma americana Smitt, op. cit. 1867, pp. 366 and 400, Pl. XX, fig. 31.

— *armifera* Hincks, Annals Nat. Hist., ser. 5, Vol. VI, p. 82, Pl. XI, fig. 5.

— — Hincks, Annals Nat. Hist., ser. 6, Vol. IX, p. 155, Pl. VIII, fig. 4.

Membranipora Sophiæ, var. armifera Waters, Journ. Linn. Soc. Zool., Vol. XXVI, p. 680, Pl. XLVIII, fig. 18.

Callopora unicornis Fleming, *var. armifera* Norman, Annals Nat. Hist., ser. 7, Vol. XI, p. 591, Pl. XIII, figs. 10, 11.

Numerous colonies on algæ, tunicata, balanus and stones.

St. 20 b, Danmarks Havn, 5—10 m.
St. 63, Stormbugt, 20—40 m.
St. 66, Stormbugt, 30—40 m.
St. 69, Stormbugt, 20—30 m.
St. 71 a, off Cape Bismarck, 30—40 m.
St. 72, Stormbugt, 20—40 m.

Membranipora cymbæformis Hincks.

Membranipora spinifera Smitt, op. cit. 1867, pp. 366 and 411, Tab. XX, fig. 32.
— *cymbæformis* Hincks, Annals Nat. Hist., ser. 4, Vol. XIX, p. 99.
Cauloramphus — Norman, Annals Nat. Hist., ser. 7, Vol. XI, p. 588.

About 10 colonies on hydroids.
St. 63, Stormbugt, 20—40 m.
St. 68 a, Øresund, 40—60 m.
St. 71 a, off Cape Bismarck, 30—40 m.

Fam. *Cribrilinidae.*

Cribrilina annulata Fabricius.

Cellepora annulata Fabricius, Fauna Groenl., p. 436.
Escharipora annulata Smitt, opus cit. 1867, Bihang, pp. 4 and 53, Pl. XXIV, figs. 8—10.
Cibrilina — Hincks, op. cit. p. 193, Pl. XXV, figs. 11, 12.
— — Waters, op. cit. p. 64, pl. 8, fig. 21.
— — Norman, East Finmark, Polyozoa, p. 94, Pl. VIII, fig. 11.
— — var. *spitsbergensis*, nov. nom. Norman, Annals Nat. Hist., ser 7, Vol. XII, p. 103—104, Pl. VIII, fig. 11.
— — Levinsen, Mosdyr, p. 62, Tab. V, figs. 23—25.
— — Osburn, op. cit. p. 232, Pl. XXIV, figs. 42, 42 a, 42 b.

The two colonies examined belong to the variety *spitsbergensis* set up by Norman. While the zooecia in all the colonies I have seen from Denmark, Norway, Iceland, Kara Sea and West-Greenland are provided with three (rarely 4) cylindrical oral spines, the oral spines in the two colonies are very broad and flattened, and Waters who has found three quite similar spines in a colony from Franz Josef Land designates them as "calcareous processes in place of the

spines." The ooecium in the main-form is very small and cap-shaped or very low, and presents, a little distally to the proximal margin, an arch-like rib formed by the union of the two outer oral spines, the ooecium in the var. *spitsbergensis*, on the other hand, is much larger, rather high, provided with a feeble longitudinal keel, and the corresponding spines are placed on each side between the ooecium and the aperture. In the only zooecium which I have seen provided with an ooecium, each of the two spines, the proximal half of which is very high and flat, is provided with an obliquely ascending and in breadth gradually diminishing distal half, which meets that from the other side with its pointed end, and together with it forms the anterior of the aperture. The geatest difference, however, between the two ooecia is that the ooecium of the main-form is represented by an independent chamber (a Kenozooecium) in connection with the distal pore-chamber of the corresponding zooecium, while that of the var. *spitsbergensis* is formed by the proximal zooecium. In *Crib. punctata*, however, both forms of ooecia may appear in the same colony.

St. 15, Lat. 76°35′ N. Long. 18°26′ W., 150 m.

St. 71 a, off Cape Bismarck, 30—40 m.

Subordo Ascophora.

Fam. *Hippothoidæ*.

Hippothoa hyalina L.

Cellepora hyalina Fabricius, Fauna Groenl. p. 435.

— *nitida* Fabricius, Fauna Groenl. p. 435.

Mollia hyalina Smitt, op. cit. 1867, Bihang, pp. 16 and 109, Tab. XXV, figs. 84—87.

Schizoporella hyalina Hincks, op. cit. p. 271, Pl. XVIII, figs. 8—10.

Diazeuxia (*Cellepora*) *hyalina* Jullien, Mission scientifique du Cap Horn, VI, Zoologie, 1888, Bryozoaires, p. 29—33, pl. 4, figs. 1—4.

Schizoporella hyalina Levinsen, "Hauch"s Togter, 1891, Polyzoa, p. 246—306, Tab. III, figs. 10—15.

— — Levinsen, Mosdyr, Zoologia Danica, 1894, Hefte 9, p. 66—68, Tab. V, figs. 42—43.

Hippothoa hyalina Waters, op. cit. p. 70, pl. 8, figs. 16—18.

— — Norman, East-Finmark, Polyzoa, p. 108.

Numerous small colonies on algæ.

St. 63, Stormbugt, 20—40 m.

St. 66, Stormbugt, 30—40 m.

St. 69, Stormbugt, 20—30 m.
St. 71 a, off Cape Bismarck, 30—40 m.
St. 72 c, Stormbugt, 15—20 m.
St. 95 a, The Sound between Renskæret and Maatten, 50—100 m.

Hippothoa expansa Dawson.

Hippothoa expansa Hincks, op. cit. p. 291, pl. 1, fig, 1.
— — Waters, op. cit. p. 69, pl. 8, fig, 19.

A single colony on a stone.
St. 71 a, off Cape Bismarck, 30—40 m.

Genus *Harmeria* Norman.

The zooecia lack a covering membrane, the calcareous matter is very thin and brittle and there are no spines. They present a larger or smaller distinctly defined frontal area, provided with numerous pores. A compound operculum feebly chitinized. Rosette plates with few pores. No ooecia and no avicularia. The disciform colony presents two different sizes of zooecia, larger inner and smaller outer.

When provisionally I refer the characteristical genus *Harmeria* to the *Hippothoidæ* it is because it agrees with the members of this family in significant characters, and at the same time does not show the faintest relationship to any other family, as far as I can see. In the first place the calcareous matter is, like that found in the Hippothoidæ, very thin, glassy and brittle, and presents the same five both longitudinal and transverse striation. There are no spines but the hollow rostriform suboral projection, often developed in *H. scutulata*, may be compared with similar projections in *Hippothoa*. As in the Hippothoidæ the calcification takes place simultaneously with the growth, while in other Bryozoa the zooecium as a rule attains its complete size before the calcification begins. Though the colonies have been preserved in spirit for five years I cannot doubt that the lack of a covering membrane over the frontal surface is not due to the state of conservation, as I have found a distinct covering membrane in the ancestrula as well as in the undeveloped zooecia and, besides, the pores also present a distinct membrane.

On the other hand *Harmeria* differs from the other Hippothoidæ in the lack of pore-chambers and of ooecia.

Harmeria scutulata Busk.

Lepralia scutulata Busk, Quarterly Journ. Micr. Sc., Vol. II, p. 255, Zoophytol., Tab. III, figs. 1—2.

Discopora scutulata Smitt, op. cit. 1867, Bihang, pp. 25 and 165, Tab. XXVII, figs. 160—161.
Cibrilina — Nordgaard, System. Fortegn., Cheilostomata (Bergens Museums Aarbog, 1894—95) No. 11, p. 20.
Harmeria — Norman, East Finmark, Polyzoa, Annals Nat. Hist., 7 S., Vol. XII, 1903, p. 107—108. (Pl. XIX, figs. 15, 16, 17).

As the species seems to be subject to great variation in different localities and, besides, needs a more thorough examination, I shall here give a description of the form taken on the Denmark expedition.

I have seen a large number of young colonies in different stages of growth, but only in four of them is the ancestrula perfectly surrounded by zooecia, and in a similar number only a small proximal portion of its circumference is still free. The named colonies have a largest diameter of c. 3—3,5 mm.

The ovate ancestrula is membraniporidan, and the membranous frontal area, in the distal portion of which is seen an opercular valve, takes up the whole frontal area, being only surrounded by a low calcareous frame without spines. In the closed colonies the ancestrula is in connection with five larger and three smaller zooecia, the latter of which join the proximal end, and in the above mentioned, not wholly closed colonies the five larger zooecia are also present, while one or more of the smaller proximal ones are absent. The five larger zooecia are still in connection with 3—8 others of the same kind, and therefore the whole number of the larger zooecia found in the above 8 colonies are 8—10, but before the three proximal zooecia have been developed, the larger zooecia are surrounded by numerous smaller ones.

The very convex zooecia possess a completely calcified basal wall, which distally to the basal margin of the distal wall presents an angularly bent mark. It is undoubtedly due to the difference in thickness between the proximal (elder) and the distal (younger) zooecium, and therefore it is most distinct in the younger portion of the colonies. The lateral walls, which are independent, are in their distal half provided with a rosette-plate with 3—6 pores, and the curved or feebly angular distall wall, which is more or less ascending frontally, presents on each side a similar rosette-plate. In a single case I have seen a single median many-pored rosette-plate.

The aperture is provided with a concave proximal margin and at each side is seen an indistinct projection which indicates the boundary between the valvular and the accessorial portion of the feebly chitinized compound operculum. The aperture of the larger zooecia is as high as broad, semielliptical-quadrangular and provided

with a more or less developed suboral peristome, while that of the smaller ones is half as broad as high, nearly semicircular, and provided with a more developed peristome, which as a rule also extends along the lateral margins. In very few zooecia the peristome is provided with a short oral rostrum. The semi-elliptical, semicircular or quadrangularly rounded poriferous area, which in the larger zooecia at the utmost attain the half length of the whole suboral area, sometimes only a third part of its length, is more developed in the smaller zooecia, but I have never seen it occupy the whole frontal area.

The difference in size between the two forms of zooecia is greatest where they are in connection with each other, and thence as a rule the smaller zooecia gradually increase in size and especially in breadth outwards. At the same time the aperture gradually increases in size and especially in height, and we may find in the margin of the colony a larger or smaller number of zooecia the aperture of which is more or less alike to that of the larger ones. As a rule these zooecia are much shorter, but not rarely broader than the latter, but sometimes we may find in a colony 1—3 singly placed zooecia of quite the same form and structure as those surrounding the distal part of the ancestrula, and in some cases I have seen that such a zooecium plays the part as ancestrula to a marginal sub-colony.

Nordgaard mentions that in the colonies examined by him the zooecia in the central portion were glistening and transparent, but the peripheral ones gray and intransparent. I have seen the same in a single colony, and the cause hereof is that the central zooecia have lost the polypides.

St. 66, Stormbugt, 30—40 m.

St. 72 c, Stormbugt, 15—20 m.

Fam. *Escharellidæ.*

Escharella ventricosa Hassall.

Discopora coccinea, forma ventricosa Smitt, op. cit. 1867, Bihang, pp. 26 and 172.

Mucronella ventricosa Hincks, op. cit. p. 363, Pl. L, figs. 6—8.

— — Osburn, op. cit. p. 243, Pl. XXVI, figs. 59, 59 a.

The aperture which is surrounded by 4, rarely by 5 or 6 oral spines is provided with a fairly broad, but very low median tooth, the margin of which is straight or a little concave. The suboral peristome is provided with a well-developed, triangular, acuminate somewhat flattened mucro and the whole of the calcareous surface

is covered with small, narrow linear projections, which in the frontal surface are directed towards the mucro and in the ooecium towards the middle of the proximal margin. In various places of the circumference the frontal surface is provided with 1—3 series of marginal pores. The ancestrula which together with a number of surrounding zooecia possesses 6(—5) oral spines has a similar structure like the other zooecia.

This species has been found on algæ and stones, and especially on stones it appears as large extensions.

St. 63, Stormbugt, 20—40 m.

St. 69, Stormbugt, 20—30 m.

St. 71 a, off Cape Bismarck, 30—40 m.

Escharella indivisa n. sp.

(Pl. XX, figs. 1, 2).

The zooecia which have a more or less regular, hexagonally rhombic form are very convex, finely granular, and surrounded by a single, distally sometimes double row of small marginal pores. The aperture, which is almost twice as broad as high and provided with a rather low, but distinct oral arch, may be surrounded by 6 spines, but in most zooecia the two median ones are absent, and this is always the case in the ooeciferous zooecia. The suboral peristome is provided with a very broad, flattened, triangularly rounded or trapeziform not pointed rostrum, and within this is seen a large, vertically projecting very broad, but rather low median tooth with a straight or even a little convex margin, and on each side, as a rule, with a very small tooth-shaped projection. The large, semi-globularly convex balloon-shaped ooecia, which from the proximal margin increase in breadth towards the middle, and here not rarely are about twice as broad as high, are provided with a depressed, somewhat everted marginal portion, which is a little protracted in the form of a small shade. In the other species of this genus examined by me, each of the three original elongate pore-chambers is divided by transverse septa into a number of small uniporous chambers. In this species, on the contrary, only the distal wall is divided in this way (as a rule only into a small median and two larger lateral chambers) while the lateral ones are undivided.

The ancestrula is provided with 9 spines, four of which surround the aperture, while the 5 others surround a somewhat depressed cryptocyst. The aperture is provided with a concave proximal margin.

St. 71 a, off Cape Bismarck, 30—40 m.

St. 72, Danmarks Havn, 10—15 m.

Escharella labiata Boeck [1].

(Pl. XX, figs. 3, 4, 5, 6, 7, 8, 9).

The zooecia are large, ovate, densely granular, very much convex and surrounded by (1—3) rows of small marginal pores. The surface is strongly ascending towards the aperture, the proximal portion of which is very much projecting, spout-shaped; a short way within its free margin is seen a very broad, low median tooth. The distal margin is armed with 2—3 spines, and there is found a strongly developed, proximally and basally directed vestibular arch, the free margin of which is triangularly rounded and on each side provided with a more or less distinct incurvation. Its length is contained 4—5 times in that of the whole zooecium. The very convex cap-shaped granular ooecia, which, when the colony is regarded from the frontal surface, present an almost semi-circular outline, are set far aback, their longitudinal axis being directed obliquely towards the basal wall. Each of them is developed from a distal zooecium, and not as in *E. abyssicola* from a Kenozooecium. Between the ooecium and the aperture is found a short obliquely inwards directed spine on each side. The three original pore-chambers are as in most species divided into a large number of small chambers.

Two small pieces on the rudiments of a shell.

St. 63, Stormbugt, 20—40 m.

Escharella abyssicola Norman.

Mucronella abyssicola Hincks, Op. cit. p. 369, Pl. XXXVIII, figs. 1, 2.
Mucronella laqueata Hincks, Op. cit. p. 368, Pl. LI, fig. 8.
Escharella abyssicola Norman, East Finmark, Polyzoa, Annals Nat. Hist., S. 7, Vol. XII, p. 117.
— — Levinsen, Cheilost. Bryozoa p. 315.

(Pl. XX, figs. 10, 11, 12, 13, 14).

The zooecia are ovate or rhombical, more or less convex, densely granular, and surrounded by a single row of fairly large punctures. The aperture is nearly semi-circular and surrounded by a more or less well developed almost tubular peristome open only between the two distally placed and nearly approximate spines, with the outer sides of which it is connate. The peristome, the proximal portion of which is often provided with a short screen-shaped projection, is more or less distinctly separated from the adjoining part of the frontal wall, and may sometimes be almost vertically pro-

[1] In Levinsen's manuscript this species was designated as *Escharella* n. sp., but O. Nordgaard identified it with *E. labiata* Boeck. (See O. Nordgaard, Hydr. and Biol. Invest. Norw. Fiords, p. 170, Pl. IV, figs. 25, 26, 31. Bergen, 1905).

jecting. There is a broad low median tooth, the corners of which are sometimes a little pointed. The well-developed oral arch, the height of which is contained 10—12 times in that of the whole zooecium, is more or less sharply divided into a larger median portion, provided with a more or less convex margin, and two much lower lateral portions. The small fragments described above have no ooecia, but I have examined colonies from several other localities, the ooecia of which are developed from kenozooecia. The punctures in the margin of the ooecia of *E. laqueata* mentioned by Norman and Hincks belong really to the surrounding kenozooecia. In the description of *E. abyssicola* they are not mentioned.

Two small fragments of old injured colonies on a stone.

St. 15, Lat. 76°35′ N. Long. 18°26′ W., 150 m.

St. 20, Danmarks Havn, 5—20 m.

This species is subject to great variation, and colonies from different localities show diversities in the form of the ooecia, the median tooth and the vestibular arch.

Escharoides Jacksonii Waters.

Discopora appensa Smitt, op. cit. 1867, Bihang, pp. 26 and 175, Tab. XXVII, fig. 177, 1878, p. 23.

Mucronella coccinea Bidenkap, (non Hincks), Zool. Jahrb. Syst. 10 B., 1897, p. 624, Taf. XXV, figs. 5—6.

Smittia Jacksonii Waters, op. cit. p. 87, pl. 12, fig. 18.

Peristomella coccinea Nordgaard, Meeresfauna von Bergen, Bryozoen, p. 94.

Escharoides Jacksonii Nordgaard, Bryozoa from the 2nd. Fram Expedition 1898—1902, 1906, p. 27.

A single colony on balanus sp.

St. 70, Danmarks Havn, 20—30 cm.

Schizoporella unicornis Johnston.

Schizoporella unicornis Hincks, op. cit. p. 238, Pl. XXXV, figs. 1—5. (Pl. XXIII, figs. 12, 13).

A number of small colonies on stones and on algæ. The rostrum and an unpaired avicularum are rarely developed, and in some of the colonies the zooecia are provided with two widely separated oral spines.

St. 63, Stormbugt, 20—40 m.

St. 71 a, off Cape Bismarck, 30—40 m.

St. 72, Danmarks Havn, 10—15 m.

St. 72 c, Stormbugt, 15—20 m.

Schizoporella sinuosa Busk.

Escharella linearis, forma *secundaria* Smitt, op. cit. 1867, Bihang, pp. 14 and 99, Tab. XXV, figs. 74—77.

Schizoporella sinuosa Hincks, op. cit. p. 266, Pl. XLII, figs. 1—6.

— — Osburn, op. cit. p. 238, Pl. XXV, figs. 51, 51 a.

A small colony on *Saxicava rugosa* and another on a stone.

St. 71 a, off Cap Bismarck, 30—40 m.

Schizoporella (Emballotheca) stylifera Levinsen.

Escharella stylifera Levinsen, Bryozoer fra Kara-Havet (Dimphna-Togtets zool.-bot. Udbytte), p. 321, Tab. XXVII, figs. 9—11[1].

Schizoporella condylata Nordgaard, Bryozoa from the 2nd Fram-Exped. p. 18, Pl. II, figs. 16—18.

(Pl. XXIII, figs. 3, 4, 5, 6, 7).

The zooecia which are rather convex are separated by extremely fine raised lines; the very tuberculous surface presents a number of ramified lines converging towards the aperture, the presence of which must undoubtedly be explained from the mode of calcification. There are rather few small pores, a number of which are marginal. The aperture, which is placed at the distal end, is provided with a fairly broad and deep sinus, the breadth of which is contained twice in that of the aperture, and with a distinct but low vestibular arch. The sinus is bordered by two large rounded hinge-teeth. Gradually there is developed a proximal (suboral) low peristome, provided with a low, indistinctly defined sinus, which conceals a larger or smaller portion of the primary sinus. The distinctly chitinized operculum is provided with a marginal thickening and with two muscular dots. The distal wall is provided with two, the distal half of each lateral wall with three rosette-plates with 1—3 pores.

The ooecia, the endoooecium of which is distinctly translucent, are a little broader than high, nodulous, not very convex and their cryptocyst is formed by three different pieces (one distal and two proximal) rising from the three surrounding zooecia and meeting each other in three sutures. At their point of union there is often seen a small pore.

The two small colonies from the Kara Sea, on which in my first paper on Bryozoa I founded *E. stylifera,* agree in all essentials with Nordgaard's *S. condylata,* but as I have overlooked the sutural lines and regarded the opercular muscles of some zooecia as styliform processes from the margins of the aperture, it has not been possible

[1] Not as indicated p. 17, 8—10.

for this author to recognize the identity of this species. The sutural lines of the ooecia are much finer than in the colony from the Danmark Expedition and they are absent in some of the ooecia, which are surrounded only by a single zooecium. Only a number of marginal pores are found.

Porinula n. g.[1]

The zooecia which seem to lack a covering membrane are provided with a well-developed tubular peristome, in the proximal portion of which there is found a tubular pore. A distinctly defined operculum. No vestibular arch. A calcified ectoooecium with or without pores. The ancestrula has a similar structure as the other zooecia. A few small colonies have been found on stones and balanus.

St. 63, 70, 71 a.

The ooecia are without pores and the pores without marginal processes.

Microporella ciliata Pallas.

Porina ciliata Smitt, op. cit. 1867, Bihang, pp. 6 and 58, Tab. XXIV, figs. 13—16.

Microporella ciliata Hincks, op. cit. p. 206, Pl. XXVIII, figs. 1—8.

— — Levinsen, Mosdyr, p. 64, Tab. V, figs. 33—35.

— *arctica* Norman, Ann. Nat. Hist. Ser. 7, Vol. XII, p. 105.

— — Osburn, op. cit. p. 233, Pl. XXIV, figs. 44—44 c, Pl. XXX, fig. 90.

A very small colony on a stone.

Locality uncertain, probably Stormbugt.

Escharina vulgaris (Moll.).

Mollia vulgaris, forma *ansata* Smitt, op. cit. 1867, Bihang, pp. 14 and 104, Tab. XXV, figs. 78—80, 82.

Schizoporella vulgaris Hincks, op. cit. p. 244, Pl. XXXVII, fig. 7, Pl. XV, figs. 5, 6.

— *stormi* Nordgaard, Hydr. Biol. Inv. Norw. Fj., p. 166, Pl. V, figs. 1, 2.

— — Nordgaard, Bryozoa sec. Fram Exp., p. 17, Pl. I, figs. 10 & 11.

— *bispinosa* Nordgaard, ibidem, p. 17, Pl. II, fig. 15. (Pl. XXIII, figs. 8, 9, 10, 11).

St. 72, Danmarks Havn, 10—15 m.

[1] A species pertaining to this genus has not been found neither in the M S., nor among the figures, nor in the collection.

Fam. *Smittinidae.*

Smittina arctica Norman.

Escharella porifera, forma majuscula Smitt, op. cit. 1867, Appendix p. 9 & 10, pl. 24, figs. 36—38.

Smittia arctica Norman, Trondhjem Fiord, Polyzoa, Annals Nat. Hist. 6 S. Vol. XIII, 1894, p. 128.

Smittia Lansborovii, forma *porifera* Hincks, Annals Nat. Hist. 6 S. Vol. 1, 1888, p. 225, Pl. XIV, fig. 2.

Smittia majuscula Nordgaard, Hydrograph. and Biological Invest. in Norwegian Fiords, 1905, p. 170, Pl. IV, figs. 36—38.

Smittia porifera Osburn, op. cit. p. 245, Pl. XXVI, fig. 64.

Smittia arctica Nordgaard, Bryozoa from the 2nd Fram Exp. 1898—1902 1906, p. 29.
(Pl. XXII, figs. 1, 2, 3).

The zooecia have their whole frontal surface provided with numerous pores, among which is found a large number of small, sharply defined tubercles. The aperture is nearly circular, but provided with a broad proximal sinus divided into two smaller ones by a median tooth, more or less developed, mostly slender as a rule decreasing in breadth towards the truncated end. In rare cases it attains a larger breadth and may sometimes be bicuspidate. The sinus is bordered by two distinctly projecting lateral teeth, the tips of which are as a rule obtusely rounded. The peristome is faintly developed, and besides a more or less projecting very tuberculous distal lip there may be found a small lateral projection which is most developed in the ooeciferous ooecia. The operculum, which is faintly chitinized, is provided on each side with a chitinous ridge, the distal end of which serves as a point of attachment for the opercular muscle, while the proximal end is in connection with the corresponding lateral tooth. The convex, mostly saddle-shaped distal wall is provided on each side near to the lateral wall with 3—4 single-pored rosette-plates, and the distal half of each lateral wall with 2—3 ovate or elongate rosette-plates with 2—6 pores. A small number of these may sometimes be replaced by pore-chambers.

The very projecting sub-oral avicularium, which never conceals the median tooth has a rounded mandible which is a little longer than broad (fig. 2), and the mandibular area is at least twice as high as the sub-mandibular one.

The ooecia, which are sometimes as high as broad, very seldom take up the whole breadth of the distal zooecium. They are very convex, tuberculous, and provided with a mor eor less well-developed shade-formed projection, but only in very few zooecia have I seen

on both sides or on one side only a rudimentary triangular ooecial cover rising from the corresponding neighbouring zooecium. According to Smitt's fig. 36, there may sometimes be found in this species an ooecial cover similar to that found in *S. arctica*. A few small colonies on algæ.

St. 63, Stormbugt, 20—40 m.
St. 69, Stormbugt, 20—30 m.
St. 72, Danmarks Havn, 10—15 m.

Smittina minuscula (Smitt) Nordgaard.

Escharella porifera, forma *minuscula* Smitt, op. cit. 1867, Appendix, p. 9 & 70, pl. 24, figs. 33—35.
Smittia arctica Norman pp., Trondhjem Fiord, Annals Nat. Hist. S. 6, vol. 13. p. 128.
— — Nordgaard p. p., Norges marine Polyzoa, Bergens Mus. Aarbog 1894—95, n. 2, p. 27, pl. 1, fig. 2.
Smittia Landsborovii, var. Waters Bryozoa Frantz Josef Land (Journ. Linnæan Soc., Zoologia, Vol. XXVIII, p. 90, pl. 12, fig. 7.
Smittia arctica Nordgaard, Die Bryozoa d. westl. Norwegen, Meeresfauna von Bergen, p. 90, pl. 1, figs. 16—18.
Smittina minuscula Nordgaard, Bryozoa from the 2nd Fram Expedition 1898—1902, 1906, p. 28, Pl. III, figs. 46 and 47. (Pl. XXI, figs. 15, 16).

The zooecia have the whole surface provided with numerous fairly large pores, separated from each other by a prominent indistinctly nodulous mesh-work. The secondary aperture is nearly semi-elliptical, and the primary aperture, which has no distinct sinus, is provided with a low but fairly broad trapeziform median tooth and two lateral teeth, the rounded ends of which are not much projecting and sometimes concealed by the peristome. The faintly chitinized operculum has no longitudinal ridges. The well-developed peristome is formed in the ooeciferous zooecia by two different portions, a lower portion which rises from the avicularian chamber on each side of the transverse bar, and a higher portion rising from the adjacent margins of the two neighbouring zooecia. The latter consists of two irregular triangular plates which decrease in breadth distally and coalesce in the middle line, thus forming a transverse belt across the proximal portion of the ooecium. The convex or saddle-shaped distal wall is on each side provided with a single-pored rosette-plate, and in the distal half of each lateral wall with 2—3 single-pored pore-chambers.

The projecting avicularium, which sometimes takes up the whole breadth of the distal zooecium and as a rule conceals the median tooth, is provided with a broadly rounded mandible which is a little broader than long. The mandibular area is not twice as high as the membranous one.

The ooecia, most of which take up the whole breadth of the distal zooecium, are tuberculous, and as a rule half as broad again as high. In most of them there is found a fairly large pore a little distally to the free margin, but it is often more or less covered by the above ooecial arch.

A few (5) small colonies from algæ and from a balanus.

St. 63, Stormbugt, 20—40 m.

St. 67, Danmarks Havn, 20—30 m.

St. 70, Danmarks Havn, 20—30 m.

St. 71 a, off Cape Bismarck, 30—40 m.

Smittina reticulata-punctata (Hincks).

Escharella porifera, forma *edentata* Smitt, op. cit. 1867, Bihang, pp. 9 and 74, Tab. XXIV, fig. 39.

Lepralia reticulato-punctata Hincks, Ann. Nat. Hist. ser. 4, Vol. XIX, p. 103, Pl. X, figs. 3, 4.

Escharella — Levinsen, Dijmphna-Togtets zool.-bot. Udbytte, p. 318, Pl. XXVII, fig. 4.

Schizoporella — Nordgaard, Hydr. and Biol. Invest., p. 166, Pl. IV, figs, 16, 17.

— *harmsworthi* Waters, op. cit. p. 65, pl. 9, figs. 10—12.

Numerous small colonies on hydroids and algæ.

St. 62, Stormbugt, 10—20 m.

St. 63, Stormbugt, 20—40 m.

St. 68 a, Øresun, 40—60 m.

St. 69, Stormbugt, 20—30 m.

St. 71 a, off Cape Bismarck, 30—40 m.

St. 72, Danmarks Havn, 10—15 m.

St. 94, The Sound between Cape Bismarck and Maatten, 20—40 m.

Smittina porifera Smitt.

Escharella porifera, forma *typica* Smitt, op. cit. 1867, Bihang, pp. 9 and 70, Tab. XXIV, figs. 30—32.

Lepralia — Hincks, Annals Nat. Hist. ser. 4, Vol. XIX, p. 102, Pl. X, figs. 1, 2.

Smittia — Nordgaard, Berg. Mus. Aarbog, 1894, p. 26, Pl. II, fig. 1.

Lepralia porifera, Waters, op. cit. p. 75, pl. 8, figs. 14, 15.
Schizoporella — Nordgaard, Hydr. and Biol. Invest. p. 167, Pl. V, fig. 32.

A single small colony on a stone.
St. 71 a, off Cape Bismarck, 30—40 m.

Smittina Smitti Kirchenpauer.

Escharella Legentilii, forma *prototypa* Smitt, op. cit. 1867, Bihang, pp. 10 and 81, Tab. XXIV, figs. 47—49.
Lepralia Smitti Kirchenpauer, Die 2te deuts. Nordpol. Vol. II, p. 420.
Escharella reticulata Levinsen, Dijmphna-Togtets zool.-bot. Udbytte, p. 319, Tab. XXVII, figs. 5, 6.
Schizoporella cincta, var., Hincks, Annals Nat. Hist. ser. 6, Vol. IX, p. 154, Pl. VIII, fig. 2.
Smittia reticulata Bidenkap, Zool. Jahrb., Syst. Vol. X, p. 622, Taf. 25, fig. 3.
Schizoporella Harmsworthi Waters, op. cit. p. 65, Pl. IX, figs. 10—12.
Smittia reticulata, var., Andersson, Zool. Jahrb. Syst. B. 16, p. 544.

A single small colony on a balanus.
St. 66, Stormbugt, 30—40 m.

Smittina Jeffreysii Norman.

Smittina Jeffreysii Norman, East Finmark, p. 120.
— — Bidenkap, Fortegnelse over de arktiske Bryozoer, p. 25.

A single small colony on a stone.
St. 71 a, off Cape Bismarck, 30—40 m.

Smittina propinqua Smitt.

Eschara verrucosa, f. *propinqua* Smitt (*partim*), op. cit. 1867, Bihang, pp. 22, 146, Tab. XXVI, figs. 126—129.
Lepralia propinqua Hincks, Ann. Nat. Hist. ser. 4, Vol. XIX, p. 103, Pl. X, figs. 5—7.
Smittia — Bidenkap, Zool. Jahrb., Syst., 10 B., p. 624.
Porella — Nordgaard, Hydr. and Biol. Inv., p. 168, Pl. IV, figs. 18—20 b.
— — Osburn, op. cit. p. 248, Pl. XXVII, figs. 70, 70 a.

A number of small colonies on hydroids.
St. 63, Stormbugt, 20—40 m.
St. 68, Øresund, 40—60 m.
St. 69, Stormbugt, 20—30 m.

Cylindroporella tubulosa Norman.

Anarthropora monodon, f. *minuscula* Smitt, op. cit. 1867, Bihang, pp. 7, 64, Tab. XXIV, figs. 20—22.
Cylindroporella tubulosa Hincks, Ann. Nat. Hist., ser. 4, vol. XX, p. 528.
Porina tubulosa Hincks, Br. Mar. Pol. p. 230, Pl. XXXII, figs. 6—9.
— — Osburn, op. cit. p. 233, Pl. XXIV, figs. 42—43 c.
St. 63, Stormbugt, 20—40 m.
St. 71 a, off Cape Bismarck, 30—40 m.

Discopora scabra (Fabr.)

Millepora reticulata Fabricius, Fauna Groenl., p. 433.
Eschara scabra Fabricius, Nye zool. Bidrag, K. Danske Vid. Selsk. nat. math. Afh. 1. D., 1824, p. 29.
Cellepora scabra Smitt, op. cit. 1867, Bihang, pp. 30 and 181, Tab. XXVIII, figs. 183—188.
Rhamphostomella scabra Lorenz, op. cit. p. 94.
— *costata* Lorenz, op. cit, p. 12, Taf. VII, Fig. 12.
— — Hincks, Ann. Nat. Hist., ser. 6, Vol. III, p. 426, Pl. XXI, figs. 6—8.
— — Waters, op. cit. p. 91, Pl. 11, figs. 26, 27, Pl. 12, figs. 1. 2.
— — Osburn, op. cit. p. 244, Pl. XXVI, figs. 62—62 b, Pl. XXXI, fig. 100.
(Pl. XXIII, figs. 1, 2).

In this species there is found a more or less well-developed granular ooecial cover, which from the surrounding zooecia (or avicularia) extends in irregular lobes over a portion of the ooecial margin. In two colonies (from St. 63 and 71 a) a number of the zooecia are provided, besides the oral one, with another and much larger avicularium, which takes up the rest of the frontal surface of the zooecium. It is provided with a powerful beak, has a more or less oblique position, and is distinctly visible from the frontal surface.

Numerous colonies on ascidians, algæ, hydroids etc.
St. 62, Stormbugt, 10—20 m.
St. 63, Stormbugt, 20—40 m.
St. 68 a, Øresund, 40—60 m.
St. 69, Stormbugt, 20—30 m.
St. 71 a, off Cape Bismarck, 30—40 m.
St. 72, Danmarks Havn, 10—15 m.

Discopora plicata Smitt.

Cellepora scabra, forma *plicata* Smitt, op. cit. 1867, Bihang, pp. 30 and 184, Tab. XXVIII, figs. 189—96.

Rhamphostomella plicata Lorenz, op. cit. p. 94.
Cellepora — Hincks, Ann. Nat. Hist., 4. ser., Vol. XIX, p. 106, Pl. XI, figs. 3, 4.
Rhamphostomella plicata Waters op. cit. p. 92, Pl. 11, figs. 28, 29.
— *spinigera* Lorenz, op. cit. p. 94.
— *plicata* Nordgaard, Bryozoa 2nd Fram-Exp. p. 30, Pl. IV, figs. 49—50.

In one of the colonies (St. 71) a median tooth is not developed. Numerous colonies on algæ, hydroids, ascidians.

St. 63, Stormbugt, 10—20 m.
St. 71 a, off Cape Bismarck, 30—40 m.
St. 72, Danmarks Havn, 10—15 m.
St. 95 a, The Sound between Renskæret and Maatten, 50—100 m.

Discopora plicata var. **spinigera** v. Lorenz.
(Pl. XXI, fig. 1).

To judge from the colonies examined by me, this form must be regarded as a variety of *D. plicata*, from which it differs chiefly in being provided with 2—4 oral spines and thereby that only a small number of the zooecia are provided with avicularia, which in the specimens examined do not differ from those found in *D. plicata*. The frontal surface of the zooecia presents a similar fine reticulate mesh-work as in *D. plicata*, and the median tooth has a similar form as in the latter species. v. Lorenz mentions that *D. spinigera* is provided with two small lateral teeth, but such are also found in the zooecia of *D. plicata* and later they get covered by the peristome as in *D. spinigera*. The peristome attains a similar development as in *D. plicata*. The basal wall is in the *spinigera* as that of *D. plicata*.

Two small colonies.
St. 63, Stormbugt, 10—20 m.

Discopora ovata Smitt.

Cellepora ovata Smitt, op. cit. 1867, Bihang, pp. 31 and 187, Tab. XXVIII, fig. 197.
Rhamphostomella ovata Osburn, op. cit. p. 245, Pl. XXVI, figs. 63, 63 a.

In opposition to all the other species of this genus, in which there is only found a number of marginal pores, a larger or smaller portion of the remaining frontal surface is provided with rather numerous large pores, which in old zooecia are seated in deep pits separated from each other by a mesh-work of strong beams. Another difference is that the ooecia have no pores, but present a more or less densely nodulous surface, which is not, however, the surface of the ectoooecium but that of the ooecial cover, which here con-

ceals the whole frontal surface of the real ooecium. Sometimes it seems as if three different zooecia take part in the formation of it, and in such cases its surface consists of three different parts separated by sutural lines. In the small colony examined all the zooecia are provided with ooecia, and in most of them the ooecial cover together with the lateral margins of the aperture and laminar extension from the neighbouring zooecia takes a larger or smaller part in the formation of a peristome by extending more or less far beyond the proximal margin of the real ooecium. Such a more or less projecting shade-like extension may be provided with an entire margin, curved from side to side, or the latter is provided with one or more larger or smaller sinuations.

A small colony on algæ.

St. 63, Stormbugt, 10—20 m.

Discopora radiatula Hincks.

Cellepora plicata Smitt, (*partim*), op. cit. 1867, Bihang, Tab. XXVIII, fig. 193.

Lepralia radiatula Hincks, Ann. Nat. Hist. 4. ser. Vol. XIX, p. 104, Pl. X, figs. 9—14.

Rhamphostomella radiatula Lorenz, op. cit. p. 95, Taf. VII, fig. 9.

— — Nordgaard, Hydr. and Biol. Invest. p. 172, Pl. V, figs. 16, 17.

The tooth is high, narrow, and decreases in breadth towards the lip, which is either roundedly pointed or provided with a short straight edge. The ooecia have a semi-circular outline, and in a number of them the marginal portion is concealed by an ooecial cover.

A few small colonies on algæ.

St. 66, Stormbugt, 30—40 m.

St. 68 a, Øresund, 40—60 m.

St. 69, Stormbugt, 26—30 m.

Discopora bilaminata Hincks.

Cellepora bilaminata Hincks, Ann. Nat. Hist. 4. ser. Vol. XIX, p. 111, Pl. XI, figs. 6, 7.

Rhamphostomella bilaminata Lorenz, op. cit. p. 95, Taf. VII, fig. 11.

— — Nordgaard, Bryozoa, 2nd. Fram-Exp. p. 33, Pl. IV, fig. 57.

— — Osburn, op. cit. p. 244, Pl. XXVI, figs. 62—61 a.

In the colonies examined there is found a very deep and sometimes extremely narrow sinus between the generally large oral avicularium and the opposite rounded almost ligulate peristomial lobe. The median tooth, which is very often completely hidden by the

avicularium, is of very variable form and breadth. In most cases it is bicuspidate, but sometimes it is provided with a straight edge, and in rare cases is very narrow and acuminate. The zooecia, which do not seem to possess any pores, not even marginal ones, are provided with greatly projecting marginal ridges from which rises a number of transverse ribs, some of which are very high; in old zooecia, therefore, the frontal surface is as a rule divided into a number of very deep spaces. While some of the ooecia have no pores at all, the large plurality of them are provided with 1—7 pores, and in a number of them a larger or smaller marginal portion is hidden by an ooecial cover, rising from the surrounding zooecia.

A number of small colonies are found on hydroids.

St. 68 a, Øresund, 40—60 m.

Discopora Sarsii Smitt.

Escharoides Sarsii Smitt, op. cit. 1867, Bihang, pp. 24 and 158, Tab. XXVI, figs. 147—154.

— — Hincks, Ann. Nat. Hist. 6. ser. Vol. 1, p. 218, Pl. XIV, fig. 1.

— — Waters, op. cit. p. 85, Pl. 11, figs. 21—23.

Posterula — Jullien & Calvet, Bryoz. .... l'Hirondelle, p. 89, Pl. XI, fig. 4.

Escharopsis lobata Norman, Ann. Nat. Hist., ser. 7, Vol. XII, p. 123.

In this species the ectoooecium is provided with 1—4 pores of various form and size, but it is gradually concealed by an ooecial cover consisting of three different portions, one of which takes its origin from the distal zooecium while the two others, which are continuous with the peristome, arise from the proximal one. The tooth which is sometimes repeated once or twice is as a rule conical, with an obtusely pointed end, rarely somewhat compressed with a straight edge. The distal wall is provided with a rib-like thickening within its basal edge.

Some fragments are taken.

St. 66, Stormbugt, 30—40 m.

St. 95, The Sound between Renskæret and Maatten, 50—100 m.

Discopora pavonella (Alder).

Discopora pavonella Smitt, op. cit. 1867, Bihang, pp. 28 and 178, Tab. XXVII, fig. 181.

Mucronella — Hincks, Br. Mar. Pol. p. 376, Pl. XXXIX, figs. 8—10.

— — Osburn, op. cit. p. 243, Pl. XXVI, fig. 60.

Numerous colonies on hydroids and on balanus sp.

St. 63, Stormbugt, 20—40 m.
St. 68 a, Øresund, 40—60 m.
St. 69, Stormbugt, 20—30 m.
St. 71 a, off Cape Bismarck, 30—40 m.
St. 95 a, The Sound between Renskæret and Maatten, 50—100 m.

Porella concinna Busk.

Porella lævis, forma *Lepraliæ* Smitt, op. cit. 1867, Bihang, pp. 21 and 136, Tab. XXVI, figs. 109—111, 115—119.
— *concinna* Hincks, op. cit. p. 223, Pl. XLVI.
— — Lorenz, op. cit. p. 89, Tab. VII, fig. 7.
— — Osburn, op. cit. p. 247, Pl. XXVII, figs. 67, 67 a, 67 b, 68.

As already pointed out by Hincks, this species is subject to great variation, and such a variation is also presented by the numerous colonies incrusting stones, which have been brought home by the Denmark expedition. I have no doubt but that a close examination of the various varieties and of their mutual relation would be of the greatest interest, but as it ought to be based on so large a material as possible, it will be most convenient to publish the result of such an examination in the report on the bryozoan material of the Ingolf-expedition, which shall contain a revision of the Bryozoa material from Greenland, Iceland and the Faroes contained in our Zoological Museum.

St. 15, Lat. 76°35′ N. Long. 18°26′ W., 150 m.
St. 71 a, off Cape Bismarck, 30—40 m.
St. 72, Danmarks Havn, 10—15 m.
St. 69, Stormbugt, 20—30 m.

Porella acutirostris Smitt.

Porella acutirostris Smitt, op. cit. 1867, Bihang, pp. 21 and 132, Tab. XXVI, figs. 106—108.
— — Hincks, Ann. Nat. Hist. ser. 6, Vol. III, p. 429, Pl. XXI, fig. 5.
— — Waters, op cit. p. 83, Pl. X, figs. 1—5.
— — Osburn, op. cit. p. 248, Pl. XXVII, figs. 69, 69 a.

Two small colonies on Algæ.
St. 72, Danmarks Havn, 10—15 m.

Porella plana Hincks.

Porella Skenei Ell. & Sol., forma *plana* Hincks, Annals Nat. Hist., ser. 6, vol. 1, p. 221, Pl. XIV, fig. 8.

Porella concinna, granular var., Hincks, Ann. Nat. Hist. ser. 6, Vol. IX, p. 156, pl. VIII, fig. 6.
Porella plana Waters, op. cit. p. 79, Pl. XI, figs. 11—13.

I have seen a small fragment of an old two-layered colony.
St. 95 a, The Sound between Renskæret and Maatten, 50—100 m.

Porella fragilis n. sp.

Porella elegantula, var. *rostrata* Hincks, Annals Nat. Hist. ser. 6, Vol. I, 1888, p. 223, Pl. XV, figs. 5, 5 a, 5 b.
(Pl. XXII, figs. 4, 5, 6, 7, 8, 9).

The zooecia have no pores and no spines, and the calcareous substance is very thin, brittle, and hyaline; they are very long (about thrice as long as broad) rhombical, somewhat compressed and provided with a very convex frontal surface, the two lateral halves of which form an obtuse angle with each other. The aperture, which is perfectly concealed by the distal end of the avicularium, when the colony is regarded from the frontal surface, is placed in the very distal end of the zooecium, and forms an angle with the longitudinal axis of the zooecium, not much larger than a right angle. It is about half-elleptical, provided with a rather short, faintly projecting margin and with an oral keel, the proximal end of which is developed as a small hinge-tooth. The operculum is membranous or very faintly chitinized and provided on each side with a fairly long and very muscular ridge obliquely distally directed. The vestibulum is fixed to the very margin of the operculum. Each of the lateral walls is provided with an ovate rosette-plate with 3—5 pores placed in the angle between its distal and proximal portion, and corresponding to a hole placed in the proximal end of a neighbouring zooecium. In most cases a larger or smaller portion of this rosette-plate reaches the basal wall, and in that case it may also be regarded as a pore-chamber. The obliquely ascending distal wall, the proximal margin of which is not rarely angularly bent, is provided near to the latter with c. 6—8 pores, divided into various numbers of uniporous or polyporous rosette-plates. In a number of zooecia the basal wall is also provided with 1—3 rosette-plates with 1—4 pores or with as many holes. The ooecia which are provided with a flat shaft-like proximal portion of somewhat different length speedily increasing in breadth, are very convex, longer than broad (when the shaft-like portion is included about half as long again as broad); the distal half of their basal wall may easily be separated from the adjoining frontal wall of the distal zooecium. The ectooecium is calcified in its whole extent.

As a rule a median avicularium is found in every zooecium, and takes up more than two thirds, not rarely three fourths, of its whole length. It consists of two portions of different breadth, which are, however, not sharply separated from each other, namely a broader distal portion, which, when regarded from the frontal surface, is elongate ovate, and a more narrow proximal part which has about the same breadth through the whole of its length. The former, the terminal face of which represents the avicularian area is obliquely ascending, and its greatly projecting distal half which almost completely conceals the aperture, when regarded from the frontal surface, is on each side connected with the zooecium by means of a triangular calcareous plate, the free margin of which on each side reaches from a point a little distally to and outside of the hinge-tooth to a point not far from the avicularian area. The proximal portion, which is of very different breadth, is provided with a pore placed a little distally to its rounded end, but not rarely it is in a larger or shorter portion of its length divided into two, each of which is provided with its own pore.

The colonies are two-layered with compressed branches, sometimes bifurcate.

Of this species some very young colonies and some fragments of older ones have been found.

St. 63, Stormbugt, 20—40 m.

St. 95 a, The Sound between Renskæret and Maatten, 50—100 m.

Porella princeps Norman.

Monoporella spinulifera, var. *præclara*, Hincks, Ann. Nat. Hist. ser. 6, Vol. IX, p. 152, Pl. VIII, fig. 3.

Porella princeps Norman, Ann. Nat. Hist. ser. 7, Vol. XII, p. 114, Pl. IX, figs. 8—11.

Of this species I have only seen a small young colony with a diameter of c. 9 mm. I have not seen a single avicularium. A number of the zooecia are provided with a broad but very low rectangular median tooth. The ooecia which are not yet covered are very convex, a little longer than broad and provided with a more or less distinct median ridge.

On a stone.

St. 71 a, off Cape Bismarck, 30—40 m.

Porella proboscidea Hincks.

The small colony examined differs from those described by Hincks in the lack of the costæ. The surface is granular and the ooecium, the ectoooecium of which is perforated by a small fissure,

is provided with a granular ooecial cover, formed either by the distal zooecium only, or also by one or two neighbouring zooecia. I have only seen a peristome in the ooeciferous zooecia, where it consists of a triangular-ligulate extension on each side. Only in one single zooecium have I found a lateral avicularium on each side of the median one.

On a hydroid.

St. 71 a, off Cape Bismarck, 30—40 m.

Fam. *Reteporidae.*

Retepora Wallichiana Hincks.

Retepora cellulosa, forma *notopachys*, v. *elongata* Smitt, op. cit. 1867, Bihang, pp. 36 and 204, Tab. XXVIII, figs. 226—232.

— *elongata* Levinsen, Dijmphna Togtets zool.-bot. Udbytte, p. 323, Tab. XXVII, fig. 11.

— *Wallichiana* Hincks, Ann. Nat. Hist. ser. 4, Vol. XIX, p. 107, Pl. XI, figs. 9—13.

A number of fragments.

St. 63, Stormbugt, 20—40 m.

Lepraliella nov. gen.

The zooecia are provided with a distinct, not beaded or faintly so, vestibular arch, and with two well-developed hinge-teeth. A well-chitinized operculum. Avicularia of different size and position. The ooecia, the proximal portion of which is not pedicel-shaped or shaft-like, have no pores and are not provided with an inwards directed tongue.

In my work on the cheilostomatous bryozoa I have pointed out that the zooecia in a number of incrusting species in all essential respects agree with those of the freely-branched *Reteporidae*, and that, therefore, these species must be referred to the latter, and the same holds good also for the two species described by Smitt respectively as *Lepralia hippopus* and *Cellepora ramulosa*, forma *contigua*. Provisionally I refer both of them to the above genus *Lepraliella*, but it is possible that a thorough systematic investigation of the family *Reteporidæ* will make it necessary to refer each of them to a distinct genus.

Lepraliella hippopus Smitt.

Lepralia hippopus Smitt, op. cit. 1867, Bihang, pp. 20 and 127, Tab. XXVI, figs. 99—105.

Lepralia hippopus Hincks, op. cit. p. 309, Pl. XXXIII, figs. 8, 9. (Pl. XXII, figs. 10, 11, 12, 13, 14).

The zooecia which consist of a hard, thick, glistening calcareous substance and rarely present 1—4 fairly long oral spines are more or less regularly hexagonally rhombic and separated from each other by distinct sutures. The moderately convex wavy nodulous surface is provided with 6—8 marginal pores, and the elongate aperture which is contained thrice in the length of the zooecium is placed a little proximally to the distal end. It is twice as long as broad, and the lateral margins are faintly converging towards the somewhat concave proximal margin. A distinct, but fairly low, rarely indistinctly beaded vestibular arch and two roundedly triangular hinge-teeth are found. Also a well-chitinized yellow operculum provided on each side with a longitudinal ridge is found, which serves both for the attachment of the opercular muscles and for connection with the hinge-teeth. Very often a small round projection is found proximally to the aperture. The pore-chambers, of which two are found in the distall wall and one in the distal half of each lateral wall, are small, narrow and provided with a few pores.

In a larger or smaller number of zooecia there is found an ovate avicularium varying in size, but rarely attaining the size of the aperture. It is in connection with one of the marginal pores and placed on one side of the aperture near to the margin either in the distal or the proximal portion of the zooecium.

The ooecia, which are two-layered in their whole extension and the basal halves of which are immersed in a niche-like cavity, are about as long as broad, very convex, and surrounded by an ooecial cover rising partly from the lateral portions of the proximal zooecium itself, partly from the surrounding zooecia, and the wavy-nodulous surface of this ooecial cover therefore presents 3—5 sutural lines. In such zooecia, which are destined to get ooecia, there is seen distally to the aperture a very small, nearly semi-elliptical opening leading into a small blind cavity. From the distal, convex margin of this opening the ectoooecium takes its origin, while the endoooecium rises from the proximal margin, and thence the ooecium expands round the distal half of the aperture.

Not a few colonies incrusting stones.

St. 63, Stormbugt, 20—40 m.

St. 71 a, off Cape Bismarck, 30—40 m.

Lepraliella contigua Smitt.

Cellepora ramulosa, forma *contigua* Smitt, op. cit. 1867, Bihang, pp. 31 and 189, Tab. XXVIII, figs. 198—210.

Rhamphostomella contigua Nordgaard, Hydr. and Biol. Inv. p. 172, Pl. V, figs. 18—20.

Lepralia vitrea Lorenz, Bryoz. v. Jan Mayen, p. 7, Taf. VII, figs. 4—5.

— — Andersson, op. cit. p. 542, Taf. 30, fig. 2.

(Pl. XXI, figs. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14).

The zooecia, which consist of a very hard, thick glistening calcareous substance, are hexagonally rhombical, and in the young colonies divided by distinct sutures. The very convex and, towards the aperture, strongly ascending, wavy-nodulous surface is provided with 3—5 small, widely distant pores, placed some way within the margin. The aperture, which is seated a little proximally to the distal end of the zooecium is nearly semicircular, with an almost straight or faintly concave proximal margin. It is provided with a well developed, not beaded, vestibular arch, and on each side with a large obtusely rounded hinge-tooth. Its distal margin presents 2—5, sometimes very long, spines, the direction of which is nearly vertical to the surface of the colony. As a rule there is found a well-developed, asymmetrical peristome surrounding that portion of the aperture not taken up by the spines, and consisting in most cases of a higher median outwards obliquely ascending portion and two lower lateral portions, more or less sharply separated from the median one. The distal wall is provided with one (or two) and the distal half of each lateral wall with a single pore-chamber with 1—4 pores. When there is no avicularium the peristome may be symmetrical, and is often more or less mucronate, but when an avicularium is present the median portion is connected with the distal end of the former, and by a triangular sinus separated from the adjacent lateral portion of the peristome. The operculum is well chitinized and provided on each side with a well-developed marginal ridge.

In most zooecia there is found a very long, immersed sac-shaped avicularium, provided with a triangular mandible. It stretches from about the middle of the one lateral margin and opens at the opposite corner of the aperture. It is absent in a fairly large number of the zooecia surrounding the ancestrula; the latter has a large nearly half-elliptical aperture without peristome, surrounded by 10 spines and provided with a concave proximal margin.

The ooecia, which are developed in niche-like hollows, are elongate, hood-shaped, somewhat compressed, and (in dry state) provided with a very large, semi-elliptical or roundedly triangular obliquely outwards slanting opening. They are more or less perfectly concealed by the deposition of calcareous layers. There is found a spine on each side immediately proximal to the lateral margin of the opening, while the rest of the spines are included within the ooecium.

Ooecia with a similar form and size of aperture have hitherto only been found within the family *Reteporidae;* namely in the three species *Retepora novæ zelandiæ*, *R. soladeria* and *R. imperati*, of which I have only been able to examine the latter. The ooecia are here very much compressed, avicularia-like, and therefore provided with a very long narrow aperture, which in old ooecia becomes closed by means of a calcareous lamina.

A few colonies on stones.

St. 63, Stormbugt, 20—40 m.

St. 72, Danmarks Havn, 10—15 m.

Fam. *Myriozoidae.*

Myriozoum crustaceum Smitt.

Myriozoum crustaceum Smitt, op. cit. 1867, Bihang, pp. 18 and 114, Tab. XXV, figs. 88—91.

Schizoporella — Lorenz, Bryoz. Jan Mayen, p. 87, Taf. VII, fig. 2.

— — Waters, op. cit. p. 64, pl. 8, figs. 11—13.

Myriozoum crustaceum Robertson, Univ. Cal. Publ. vol. 4, Nr. 5, p. 295, Pl. 21, fig. 54.

Leieschara plana Norman, Ann. Nat. Hist., ser. 7, Vol. XII, p. 110.

Numerous small colonies on hydroids and algæ.

St. 63, Stormbugt, 20—40 m.

St. 69, Stormbugt, 20—30 m.

St. 71, off Cape Bismarck, 30—40 m.

St. 72, Danmarks Havn, 10—15 m.

Fam. *Celleporidae.*

Cellepora incrassata Smitt.

Cellepora incrassata Smitt, op. cit. 1867, Bihang, pp. 33 and 198, Tab. XXVIII, figs. 212—216.

— *cervicornis* Lorenz, Bryoz. Jan Mayen, p. 95, Taf. VII, fig. 12.

— *incrassata* Waters, op. cit. p. 93, Pl. XII, figs. 11—14.

— — Nordgaard, Hydr. and Biol. Inv. p. 172, Pl. III, fig. 25.

A few colonies.

St. 66, Stormbugt, 30—40 m.

St. 95 a, The Sound between Renskæret and Maatten, 50—100 m.

Cellepora avicularis Hincks.

Cellepora ramulosa, forma *avicularis* Smitt, op. cit. 1861, Bihang, pp. 32 and 194, figs. 202—210.

Cellepora avicularis Hincks, op. cit. p. 406, Pl. LIV, figs. 4—6.
— — Nordgaard, Berg. Mus. Aarb. 1904, p. 98, Taf. II, figs. 37, 39.

Numerous small round colonies on hydroids.
St. 63, Stormbugt, 20—40 m.
St. 62. Stormbugt, 10—20 m.
St. 68 a, Øresund, 40—60 m.
St. 95 a, The Sound between Renskæret and Maatten, 50—100 m.

Ordo Cyclostomata.

Fam. *Tubuliporidæ.*

Idmonea atlantica Forbes.

Tubulipora atlantica, forma *erecta* Smitt, op. cit. 1865, pp. 398 and 434, Tab. III, figs. 6—7, Tab. IV, figs. 4—13.
— — Hincks, op. cit. p. 451, Pl. LXV, figs. 1—4.
— — Osburn, op. cit. p. 217, Pl. XIX, figs. 9, 9 a.

A single young colony with two zooecia in each transverse row.
St. 68 a, Øresund, 40—60 m,

Tubulipora flabellaris Fabricius.

Tubipora flabellaris Fabricius, Fauna Groenl. p. 429.
Tubulipora — Smitt, op. cit. 1866, pp. 401 and 455, Tab. IX, figs. 6—8.
— — Levinsen, Mosdyr, p. 76, Tab. VI, figs. 1—3.
— — Harmer, Quart. Journ. Micr. Sc. n. s. vol. 41, p. 99, Pl. VIII, fig. 4.
— — Osburn, op. cit. p. 218, Pl. XX, fig. 11.
— — Robertson, Univ. of California Publ. in Zoology, Vol. VI, Nr. 12, p. 247, Pl. XXI, figs. 25, 26.

A single small colony.
St. 69, Stormbugt, 20—30 m.

Tubulipora sp.
St. 71 a, off Cape Bismarck, 30—40 m.

Diastopora obelia Johnst.

Diastopora hyalina, α obelia Smitt, op. cit. 1866, pp. 396 and 421.
— *obelia* Hincks, op. cit. p. 462, Pl. LXVI, figs. 10, 10 a.

3 small colonies, two on algæ and one on a stone.

St. 63, Stormbugt, 20—40 m.
St. 71 a, off Cape Bismarck, 30—40 m.

Diastopora diastoporides Norman.

Diastopora diastoporides Smitt, op. cit. 1871, p. 1116, Tab. XX, fig. 4.
Stomatopora — Hincks, op. cit. p. 434, Pl. LXIII, figs. 3, 4.
— — Osburn, op. cit. p. 218, Pl. XVIII, fig. 12, 12 a.

Not a few colonies on stones.
St. 63, Stormbugt, 20—40 m.
St. 71, off Cape Bismarck, 30—40 m.

Fam. *Lichenoporidæ.*

Lichenopora regularis d'Orbigny.

Lichenopora regularis Hincks, op. cit. 1866, p. 479, Pl. LXVIII, fig. 11.

Of this interesting species which has been described from cretaceous specimens and has been found in recent state only at the Shetland Islands, five colonies have been found. The largest of them has a larger diameter of 13 mm.

St. 63 (4 specimens), Stormbugt, 20—40 m.
St. 72, Stormbugt, 20—40 m.

Lichenopora verrucaria Fabricius.

Madrepora verrucaria Fabricius, Fauna Groenl. p. 430.
Discoporella — Smitt, op. cit. 1866, pp. 405 and 479, Tab. X, figs. 6—8, Tab. XI, figs. 1—6.
Lichenopora verrucaria Hincks, op. cit. p. 478, Pl. LXIV, figs. 4, 5.
— — Waters, op. cit. Vol. XXIX, p. 176.
— — Osburn, op. cit. p. 219, Pl. XVIII, figs. 13—13 b.

17 colonies on algæ.
St. 63, Stormbugt, 20—40 m.
St. 66, Stormbugt, 30—40 m.
St. 69, Stormbugt, 20—30 m.
St. 71 a, off Cape Bismarck, 30—40 m.
St. 72, Stormbugt, 20—40 m.

Lichenopora crassiuscula Smitt.

Discoporella crassiuscula Smitt, op. cit. 1866, pp. 406 and 482, Tab. XI, figs. 7—9.
Lichenopora — Nordgaard, Bryozoa 2d. Fram Exp. p. 37.
— — Waters, op. cit. Vol. XXIX, p. 177.

Two small colonies, one on a stone and another on *Saxicava*.
St. 71 a, off Cape Bismarck, 30—40 m.
St. 63, Stormbugt, 20—40 m.

Ordo Ctenostomata.

Alcyonidium Mytili Dal.?

Alcyonidium Mytili Smitt, op. cit. 1866, pp. 496 and 507, Tab. XII, figs. 1—2.
— — Hincks, op. cit. p. 498, Pl. LXX, figs. 2, 3.

I am not quite sure that the small colonies examined really belong to *A. Mytili*. They agree, indeed, with the colonies of this species in the form and position of the single zooecia, the distal end of which is only very little projecting, but in opposition to what is the case in other colonies of *A. Mytili* the zooecia are very opaque.

A number of colonies on algæ.
St. 66, Stormbugt, 30—40 m.
St. 69, Stormbugt, 20—30 m.
St. 72, Stormbugt, 20—40 m.

Alcyonidium mamillatum Alder.

Alcyonidium hirsutum, forma *membranacea* Smitt, op. cit. 1866, pp. 497 and 508, Tab. XII, figs. 3—8.
— *mamillatum* Hincks, op. cit. p. 495, Pl. LXIX, figs. 7, 8.

A colony on balanus sp.
St. 63, Stormbugt, 20—40 m.

Fam. *Vesiculariidæ*.

Bowerbankia caudata Hincks.

A few colonies on hydroids.
St. 63, Stormbugt, 20—40 m.
St. 71 a, off Cape Bismarck, 30—40 m.
St. 72, Stormbugt, 20—40 m.

PLATE XIX.

PLATE XIX.

Fig. 1. *Scrupocellaria scabra* v. Ben.
Zooecia from the basal surface with pore-chambers.

Figs. 2, 3. *Scrupocellaria ternata* Ellis & Sol. var. *gracilis* Smitt.

Fig. 2. Zooecium in basal view with vibraculum and radical fibre.

— 3. Isolated vibraculum.

Figs. 4 — 7. *Membranipora (Callopora) craticula* Alder.

Fig. 4. Zooecia with large independent avicularia.

— 5. Zooecia and avicularia with pore-chambers.

— 6. Zooecia with ooecia and small avicularia placed on the top.

— 7. Ooecium and zooecium with a small lateral avicularium.

Figs. 8—10. *Membranipora (Callopora) spatulifera* Smitt.

Fig. 8. Zooecia with spatulate spines seated proximally to the aperture.

— 9. Ovate-pyriform zooecium with membraneous frontal area, lateral avicularia and an avicularium placed on the top of the ooecium.

— 10. Hexagonal zooecia with lateral avicularia and oral spines.

Figs. 11—14. *Membranipora (Callopora) Whiteavesi* Norman.

Fig. 11. Pear-shaped ovate zooecium with ovate frontal area and granular cryptocyst surrounded by a great number of spines.

— 12. Zooecium with spines of different thickness.

— 13. Zooecium with a calcareous plate in the aperture. This plate is perforated in the middle by an ovate opening and is undoubtedly the cryptocyst of a regenerated zooecium.

— 14. Zooecium with a densely granular ooecium.

Figs. 15—17. *Harmeria scutulata* Busk.

Fig. 15. Colony with an ovate membraniporidan ancestrula surrounded by 5 larger and 3 smaller zooecia.

— 16. Ancestrula with the 5 surrounding larger zooecia.

— 17. Smaller zooecia with a nearly semicircular aperture.

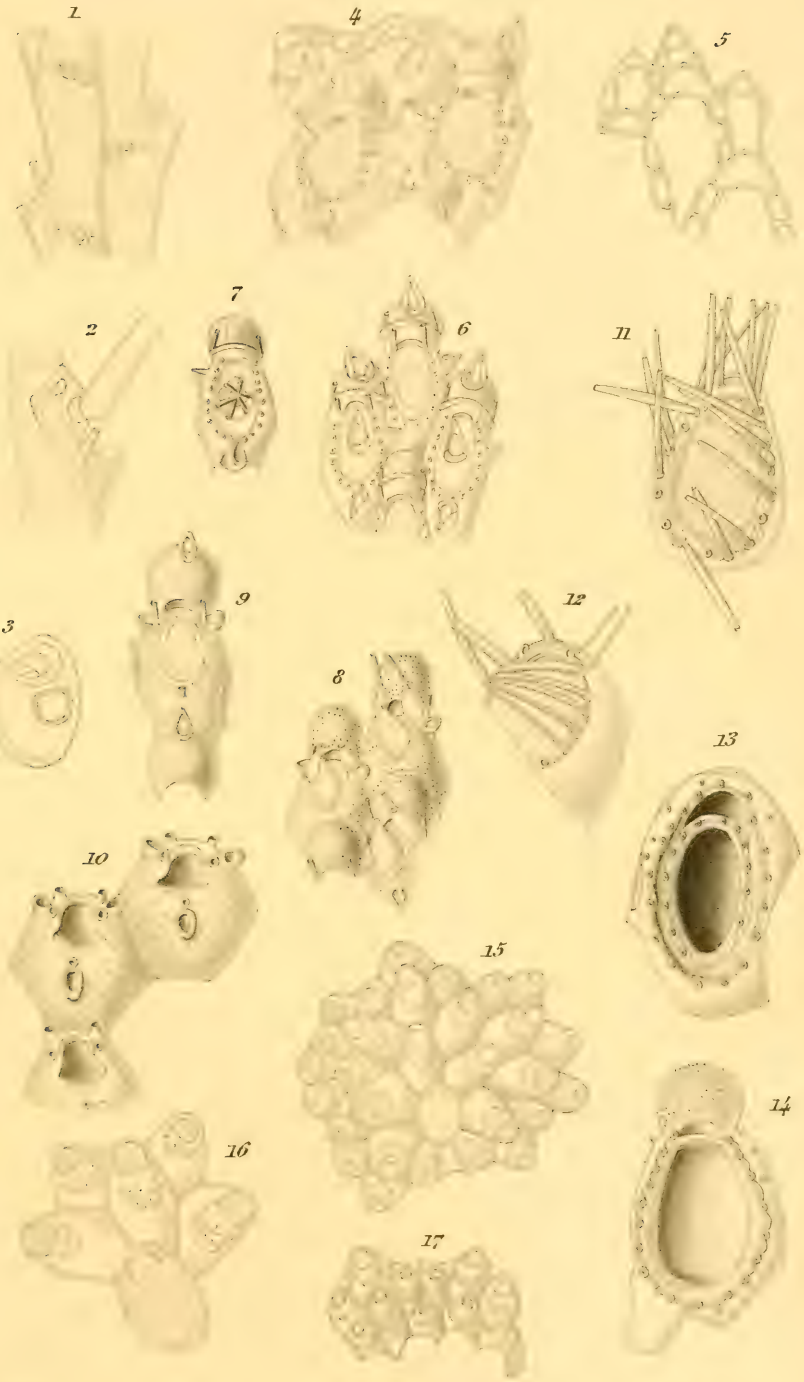


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PLATE XX.

PLATE XX.

Figs. 1, 2. *Escharella indivisa* n. sp.

Fig. 1. Zooecia and ooecia.

— 2. Zooecia in basal view showing the arrangement of the pore-chambers.

Figs. 3— 9. *Escharella labiata* Boeck.

Fig. 3. Zooecia showing the marginal pores and the spout-shaped projection towards the aperture.

— 4. Basal view of the zooecia showing the arrangement of the pore-chambers.

— 5. Upper part of a zooecium in basal view.

— 6. Lateral view of a zooecium.

— 7. Lateral view of an ooecium and the upper part of a zooecium.

— 8. Aperture with oral spines.

— 9. Base of an ooecium.

Figs. 10—14. *Esharella abyssicola* Norman.

Fig. 10. Upper part of a zooecium with oral spines and marginal pores.

— 11. Upper part of a zooecium showing the screen-shaped peristomal projection.

— 12. Aperture with surrounding spines and median tooth.

— 13. Basal wall of a zooecium.

— 14. Basal wall of an ooecium in connection with the upper part of the zooecium.

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PLATE XXI.

PLATE XXI.

Fig. 1. *Discopora plicata* var. *spinigera* v. LORENZ.
Zooecia and ooecia.

Figs. 2—14. *Lepraliella contigua* SMITT.

Fig. 2. Zooecia with avicularia.
— 3. Zooecia with oral spines.
Figs. 4, 5. Spines.
Fig. 6. Ooeciferous zooecia.
— 7. Zooecia provided with pores.
— 8. Zooecia with apertures of different forms.
— 9. Avicularium.
— 10. Triangular mandible.
— 11. Aperture with oral teeth.
— 12. Zooecium with a mucronate peristome.
— 13. Ancestrula.
— 14. Operculum showing the marginal ridges.

Figs. 15—16. *Smittina minuscula* (SMITT) NORDGAARD.

Fig. 15. Zooecia and ooecia.
— 16. Peristome of a zooecium with the avicularian chamber, median tooth and the two peristomal triangular plates.

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PLATE XXII.

PLATE XXII.

Figs. 1— 3. *Smittina arctica* Norman.
Fig. 1. Zooecia and ooecia.
— 2. Distal part of a zooecium showing avicularium, median tooth and operculum.
— 3. Operculum with the chitinous ridges.
Figs. 4— 9. *Porella fragilis* n. sp.
— 4. Zooecia and ooecia, frontal surface.
— 5. Avicularia.
— 6. Zooecia in lateral view.
— 7. Aperture.
— 8. Basal wall of the zooecia.
— 9. Operculum.
Figs. 10—14. *Lepraliella hippopus* Smitt.
Fig. 10. Zooecia.
— 11. Upper part of a zooecium showing the aperture and two triangular hinge teeth.
— 12. Zooecia with ovate avicularia.
— 13. Zooecia and ooecia with sutural lines.
— 14 a, b, c. Opercula.

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PLATE XXIII.

PLATE XXIII.

Figs. 1, 2. *Discopora scabra* Fabr.
Fig. 1. Zooecia and ooecia.
— 2. Operculum.
Figs. 3— 7. *Schizoporella (Emballotheca) stylifera* Levinsen.
Fig. 3. Zooecia and ooecia.
— 4. Zooecia in basal view.
— 5. Aperture of a zooecium with the two large rounded hinge-teeth.
— 6. Operculum.
— 7. Zooecia showing marginal pores.
Figs. 8—11. *Escharina vulgaris* Moll.
Fig. 8. Ancestrula with surrounding zooecia.
— 9. Zooecia with ooecium and avicularium.
— 10. Zooecia with marginal and frontal pores and two oral spines.
— 11. Upper part of a zooecium showing the proximal sinus and four oral spines.
Figs. 12—13. *Schizoporella unicornis* Johnston.
Fig. 12. Upper part of a zooecium with proximal sinus of the aperture and two oral spines.
— 13. Operculum with chitineous ridges.

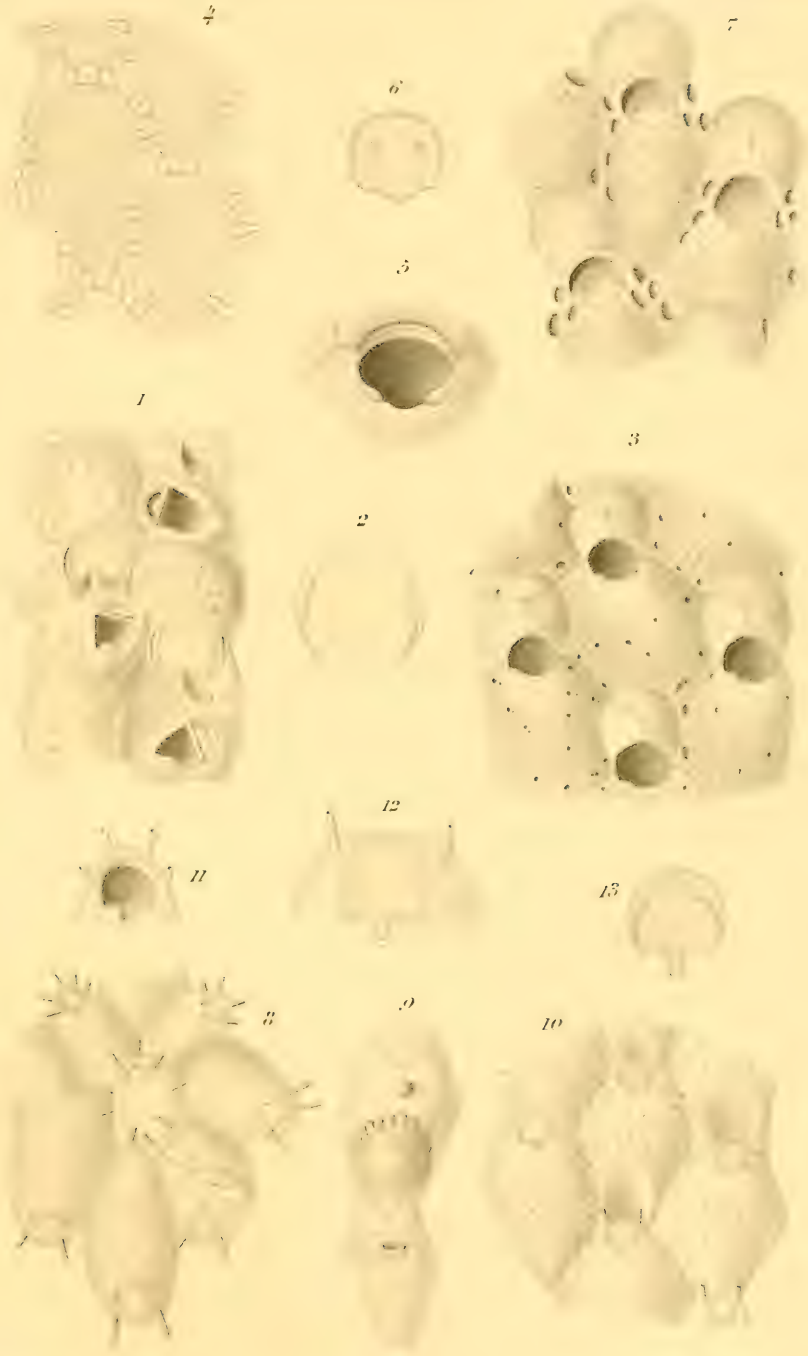
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PLATE XXIV.

PLATE XXIV.

Figs. 1, 2. *Escharella macrodonta* n. sp.

Fig. 1. Zooecia with an ooecium.

— 2. Upper part of a zooecium in basal view.

Figs. 3— 6. *Escharella stenostoma* Smitt.

Discopora stenostoma F. A. Smitt, Kritisk förteckn. öfver Skandinaviens Hafsbryozoer. Öfvers. Kgl. Vet. Akad. Förh. 1871, nr. 9, p. 1130, tab. 21, figs. 29, 30.

Fig. 3. Zooecia.

— 4. Aperture with surrounding spines.

— 5. Operculum.

— 6. Zooecium in basal view.

Figs. 7—12. *Micropora* n. sp.

Figs. 7, 8. Zooecia.

Fig. 9. Zooecia in basal view.

— 10. Operculum.

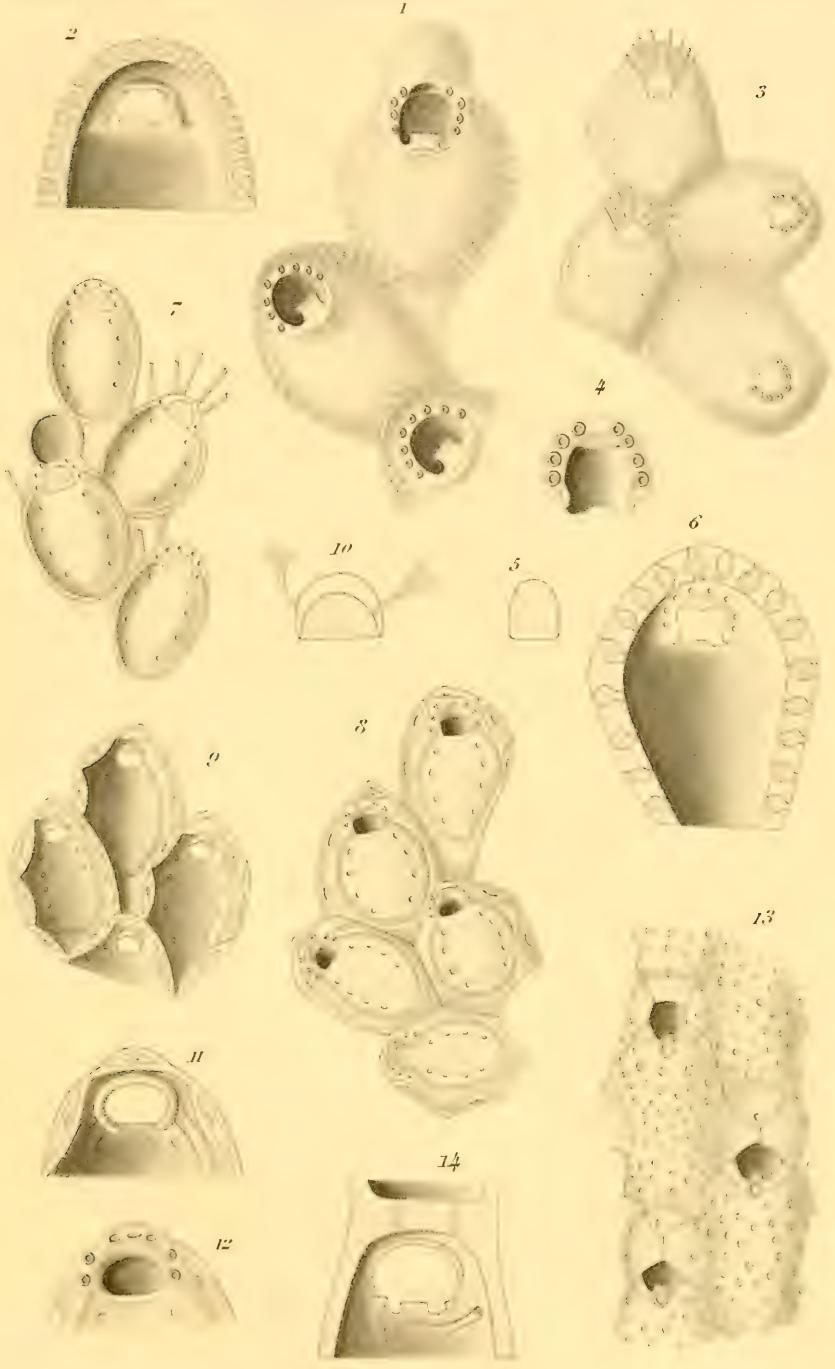
Figs. 11, 12. Upper part of a zooecium.

Figs. 13, 14. *Porella bella* Busk.

For synonyms see Norman, A month on the Trondhjem Fjord. Ann. Mag. Nat. Hist., ser. 6, vol. 13, p. 125.

Fig. 13. Zooecia and ooecia with sutural lines.

— 14. Aperture with surrounding oral denticles.



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XVII.

REPORT ON THE PORIFERA COLLECTED BY THE DANMARK EXPEDITION AT NORTH-EAST GREENLAND

BY

H. V. BRØNDSTED

The sponges treated in this paper were collected by the Danmark Expedition at North-East Greenland in 1906—08.

The material is astonishing small, only 12 species and also few specimens; whether this circumstance is due to the fact that the dredgings were nearly all undertaken in comparatively shallow water, or to other facts, it is impossible to state.

The material is for the greater part badly preserved, in not too strong alcohol; hence the condition only allowed a study on skeletal arrangement and on spicules: a purely systematic study.

The methods employed have been the usual: dry cutting for study on skeletal arrangements; isolating of spicules by means of Eau de Javelle, which proved far better than Kaliumhydroxyd.

Sponges were obtained at the following stations: 63, 64, 68 a, 72 b, 95 c, 96, 99, 104 b.

The material is much too small to yield matter for a discussion on any biological topic, its value in itself is mainly to contribute to our knowledge on arctic sponge-stock; but in connection with the more considerable materials of other arctic expeditions (as that of the Danish Ingolf-Expedition) it will also possess biological (mainly zoogeographical) interest.

As to the paper itself the following is to be said: 12 species are mentioned: *Calcareous*: *Leucosolenia coriacea* Mont., *Grantia arctica* H., *Leuconia ananas* Mont., *Hexactinellides: Rhabdocalyptus arcticus* nov. spec., *Asconema setubalense* Sav. Kent., *Monaxonides: Halichondria tenuispiculata* nov. spec., *Reniera cinerea* Grant, *Reniera laxa* Ldbck., *Mycale thaumatochela* Ldbck., *Lissodendoryx indistincta* Frstdt., *Lissodendoryx complicata* Arm. Hans., *Higginsia pyriformis* nov. spec. As will be seen, 3 of these are new species; the remaining 9 species are so well known, described and figured that further report is superfluous.

The figures are all drawn by myself, Pl. XXV by means of Abbes drawing-apparatus from Zeiss. The microscope employed was a Stativ from Zeiss with acromatic systems, oculars of Huyghens.

I shall here express my gratitude to the late Inspector G. M. R. Levinsen of the Zoological Museum of Copenhagen, and to Inspector W. Lundbeck, also of the Zoological Museum, for several valuable hints concerning the preparing of this paper.

PORIFERA

Class I. Calcarea.

Order I. *Homocoela.*

Fam. Asconidae.

Genus Leucosolenia Bow.

Leucosolenia coriacea Mont.

1818. *Spongia coriacea* Montagu [21], p. 116.
1842. *Grantia* — Johnston [13], p. 183, Pl. XXI, fig. 9.
1866. *Leucosolenia coriacea* Bowerbank [3 b], p. 34.
1872. *Ascetta* — Haeckel, [11], II, p. 24, Taf. 3, Taf. 5.
1887. — — Fristedt, [8], p. 405, Pl. 22, fig. 1—2.

3 specimens; color dark brown; greatest length ca. 18 mm., thickness 1—2 mm.

Station 63. Stormbugt, hard bottom, 20—40 m.

Geographical distribution: Cosmopolitan.

Depth: 0—1000 m.

Order II. *Heterocoela.*

Fam. Syconidae.

Genus Grantia Flem.

Grantia arctica H.

1872. *Sycandra arctica* Haeckel [11], p. 353, Taf. 55, fig. 1 a-v; Taf. 60, fig. 15.
1883. *Sycon* — Polejaeff [22], p. 40, Pl. III, fig. 5.
1898. *Grantia* — Breitfuss [4], p. 302.
1898. — — — [5], p. 21.

3 specimens; greatest length 20 mm., breadth 10 mm.; one of the specimens (from Station 95 c) with comparatively slender rhabdes, but then a few more in each bundle.

Station 68 a. Off Cape Bismarck. 40—60 m.
— 72 b. Danmarks Havn. 10—20 m.
— 95. The sound between Renskæret and Maatten. 50—100 m.

Geographical distribution: Arctic circumpolar.

Depth: 20—2000 m.

Fam. Leuconiidae.

Leuconia Grant.

Leuconia ananas Mont.

1818. *Spongia ananas* Montagu [21], p. 97, Pl. 16, figs. 2—3.
1872. *Leuconia* — Haeckel [11], p. 200, Taf. 32, fig. 5 a—f, Taf. 40, figs. 1—8.
1898. — — Breitfuss [4], p. 223.
1898. — — [5], p. 31.

One specimen, oval, length 10 mm., breadth 4 mm., color whitish yellow.

Station 63. Stormbugt, hard bottom, 20—40 m.

Geographical distribution: Greenland, Spitzbergen, Murman-coast, White-Sea, off Norway, Shetland Islands, English coasts, Normandy.

Depth: 10—130 m.

Class II. Hexactinellida.

Subclass I. Lyssacina.

Order I. *Hexasterophora.*

Fam. Rossellidae.

Genus Rhabdocalyptus Jij.

Rhabdocalyptus arcticus nov. spec.
Pl. XXV, Pl. XXVI, figs. 1—7.

The present form is perhaps not at all a *Rhabdocalyptus*, but for the present I refer the sponge to this genus, because its structure and the greater part of the spiculation agree with those of *Rhabdocalyptus*. The fact that makes me doubtful as to the right genus-determination is, that discohexacts are missing entirely, so far as I have observed. The referring of the form to the genus *Bathydorus* is contradicted by the presence of the big prostalia pleuralia.

The sponge (Pl. XXV) is cylindrical, somewhat compressed and constricted towards the summit and the base; 3 specimens form a little colony, the one, however, nipped off. The oscular opening has a diameter of ca. 30 mm. in the biggest specimen, in the smaller ca. 20 mm. The length of the biggest specimen is ca. 110 mm., by 40 mm., of the smaller 80 by 25 mm. The wall varies in thickness

from 1—ca. 8 mm., the consistency is like that of loose felt; color grey; the surface (both dermal and gastral) hispid. The characteristic *pentactine prostalia pleuralia* project 4—5 mm. from the dermal surface of the sponge, the cross naturally placed distally, outside the spongebody; these pentacts, whose rays are imbedded in mud, are only found in a few places, especially where the 3 individuals together form a corner; in other places they are rubbed off (on the figure, Pl. XXV, more are drawn than really observed). The summits of the sponge-individuals are provided with a damaged fringe of *prostalia marginalia.* The canal system and skeletal arrangement are as in the *Rosellidae* in general, and *Rhabdocalyptus* especially.

Spiculation. 1°. *Oxydiacts*, length about 10 mm., form the main skeleton, in fibres principally parallel with the sponge-surface; 2°. *Pentacts* (Pl. XXVI, fig. 4), ca. 6 mm., very strongly hispid (a pronounced *Rhabdocalyptus* criterion); these form the *prostalia pleuralia*, but are also imbedded in the sponge-corpus itself, the tangential rays immediately beneath the dermal membrane; 3°. *Oxypentacts*, (Pl. XXVI, fig. 3), hispid, sustaining the dermal membrane, the distal radial ray rudimentary (criterion for *Rosellidae*). 3 a°. *Oxypentacts*, smooth, the radial ray 3—5 times the tangential ones, in the dermal membrane (?) very rarely found; I regard these spicules as strange elements to the sponge itself. 4°. *Oxyhexasters*, hispid, (Pl. XXVI, fig. 2) form the gastral skeleton (Pl. XXVI, fig. 1), and are also distributed in the parenchyma. 5. *Oxydiacts* (Pl. XXVI, figs. 5—5 c) hispid, the ends rather blunt, a swelling near the middle, a swelling which often assumes the form of 4 knots or even 4 short rays; distributed in the parenchyma. 6°. *Diacts* (Pl. XXVI, fig. 6—6 b) styliform, hispid, length 1—2 mm., somewhat bent near the blunt end, where the axial cross is to be found. 7°. *Oxyhexacts* (Pl. XXVI, figs. 7—7 a) hispid, ca. 0,120 mm.; one or more rays often divided in two (fig. 7 a), always bent in the end; occur everywhere in the sponge.

Station 104 b. Lat. 76°06′ N. Long. 13°26′ W., gravelled clay bottom.

Depth: 250—200 m.

Fam. Asconematidae.

Subfam. Asconematinae.

Genus Asconema Saville Kent.

Asconema setubalense Sav. Kent.

1870. *Asconema setubalense* Saville Kent [14], p. 241.
1887. — — Schulze [26], p. 116, Pl. XXI.

The specimens in hand fully agree with the descriptions given of *A. s.* in the litterature. Whether the fragments have formed one or more specimens, it is impossible to state. The biggest fragment has an extension of ca. 150 mm.

Station 104 b. Lat. 76°06′ N. Long. 13°26′ W., gravelled clay bottom.

Depth: 250—200 m.

Geographical distribution: Atlantic to Arctic ocean.

Class III. Demospongiae.

Subclass I. Monaxonida.

Order *Halichondrina.*

Fam. Homorrhaphidae.

Subfam. **Renierinæ.**

Genus **Halichondria** Flem.

Halichondria tenuispiculata nov. spec.

One specimen, somewhat damaged, 25 mm. in length, breadth 10 mm.; consistency tolerably firm; color yellowish brown; surface finely hispid; ostiae ca. 0,1—0,2 mm. in diameter. In the skeleton one can just distinguish vague beginnings towards polyspicular fibres, some of these tending towards the surface of the sponge, and ending with spicules projecting slightly beyond the surface, making this hispid; dermal membrane very delicate, transparent.

The characteristic of the species is, however, the spicules: These are *oxea* (Pl. XXVI, fig. 8 a—d), slightly bent in the middle, rather abruptly pointed, with nearly parallel edges; the length rather constant, about 0,180 by 0,008 mm.: smaller than in any *Halichondria* species, so far as I know; many developmental forms of spicules are found.

Station 63. Stormbugt, hard bottom.

Depth: 20—40 m.

Genus **Reniera** Nardo.

Reniera cinerea Grant.

1827. *Spongia cinerea* Grant [9], p. 204.
1842. *Halichondria cinerea* Johnson [13], p. 110, Pl. IV, fig. 4.
1866. *Isodictya* — Bowerbank [3 b], p. 241, Pl. XLVIII, figs. 1—5.

1870. *Reniera cinerea* O. Schmidt [25], p. 77.
1902. — — Lundbeck [17], p. 43, Pl. XI, fig. 10.

Some insignificant, damaged specimens, color brownish, on *Delesseria sanguinea.*

Station 72 c. Stormbugt. 15—20 m.

Geographical distribution: Greenland, Jan Mayen, Mossel Bay, Gullmaren, English coasts, The Philippines, British Columbia.

Depth: 20—200 m.

Reniera laxa Ldbck.

1902. *Reniera laxa* Lundbeck [17], p. 46, Pl. II, fig. 6, Pl. XI, flg. 13.

2 specimens agree with the description given by Lundbeck, only the average length of oxea is slightly smaller than in the specimens from the Ingolf Expedition (as the original specimen is found in the Zoological Museum in Copenhagen I have had it for examination). Specimens in hand 5—8 mm., on *Delesseria.*

Station 72 c. Stormbugt. 15—20 m.

Geographical distribution: Davis Strait to Iceland.

Depth: 100—200 m.

Fam. Desmacidonidae.

Subfam. Mycalinae.

Group 1. *Mycaleae.*

Genus **Mycale** Gray.

Mycale thaumatochela Ldbck.

1897. *Esperella intermedia* Vanhöffen [29], p. 248.
1905. *Mycale thaumatochela* Lundbeck [18], p. 39, Pl. X, figs. 2 a—g.
1909. — — — [20], p. 437.

3 specimens, incrusting on Balanus-shells, at largest 1 mm. thick, ca. 10 mm. in length; agrees with Lundbecks specimens, only the styli may diminish to 0,300 mm.

Station 63. Stormbugt. 20—40 m.
— 94. The sound at Cape Bismarck, 20—40 m.

Geographical distribution: Greenland.

Depth: 20—60 m.

Group 2. *Myxilleae.*

Genus **Lissodendoryx** Tops.

Lissodendoryx indistincta Frstdt.

1887. *Hastatus indistincta* Fristedt [8], p. 444, Pl. 25, figs. 13—19.
1905. *Lissodendoryx indistincta* Lundbeck [18], p. 162, Pl. V, fig. 10, Pl. XVI, fig. 3 a—h.

1909. *Lissodendoryx indistincta* Lundbeck [20], p. 440.

Several damaged specimens, one of them completely filled with sand. Fully agree with the description given by Lundbeck. Color yellowish to light-grey.

Station 63. Stormbugt, hard bottom, depth 20—40 m.

Geographical distribution: Greenland, Spitzbergen.

Depth: 10—200 m.

Lissodendoryx complicata Arm. Hans.

1885. *Reniera complicata* Armauer Hansen [12], p. 7, Pl. I, fig. 8, Pl. VI, fig. 8.

1885. *Myxilla grisea* Armauer Hansen [12], p. 12, Pl. I, fig. 3, Pl. VI, fig. 9.

1887. *Clathria corallorhizoides* Fristedt [8], p. 460, Pl. 25, figs. 73—77, Pl. 29, fig. 23.

1905. *Lissodendoryx complicata* Lundbeck [18], p. 167, Pl. V, fig. 11, Pl. XVI, figs. 4 a—9.

1909. — — — [20], p. 440.

Of this beautiful sponge we have 2 specimens; greatest extension ca. 80 mm. Spiculation as in Lundbecks description. On gravel. Color white-yellowish.

Station 96. Off Maroussia. 160—180 m.

Geographical distribution: Greenland, Arctic Sea.

Depth: 300—1400 m.

Fam. Axinellidae.

Genus **Higginsia** Higgins.

Higginsia pyriformis nov. spec.

Sponge small, pear-shaped, with a long slender stalk; the whole length barely 10 mm., the corpus itself 3 mm. by 2 mm.; diameter of stalk ca. 0,3 mm. Osculum at the top of the sponge, diameter ca. 0,4 mm.; a delicate transparent dermal membrane covers the body; color yellowish-brownish, stalk, however, white and clear on account of the small amount of organic matter found in it. The skeleton composed of spiculo-fibres ascending from the base, forming the stalk, ending at the summit, and forming a little spiculo-fringe surrounding the osculum.

Spiculation: Of the known *Higginsia* species *H. pyriformis* mostly resembles *H. Thielei* Topsent as to the spiculation. But in *H.*

pyriformis only two sorts of spicules are found: 1°, *Megascleres tylostyles* (Pl. XXVI, figs. 9—9 b) of a very elegant form; slightly curved, the greatest thickness is about the middle, then gradually tapering to both ends; very finely and quite near the end rather abruptly pointed; 0,60—0,43 mm. by 0,014—0,010 mm. 2°, *Microscleres oxea*, (Pl. XXVI. fig. 10), follow the tylostyles, spined, slightly bent, with a constant swelling near the middle, form much varying; 0,020—0,055 by 0,002—0,003 mm.

Station 99. Lat. 77° N. Long. 17½° W. 300 m.

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20.—5.—1916.

PLATE XXV.

PLATE XXV.

1/1. *Rhabdocalyptus arcticus* nov. sp. pag. 477.

Brøndsted del. *Pacht & Crone phototyp.*

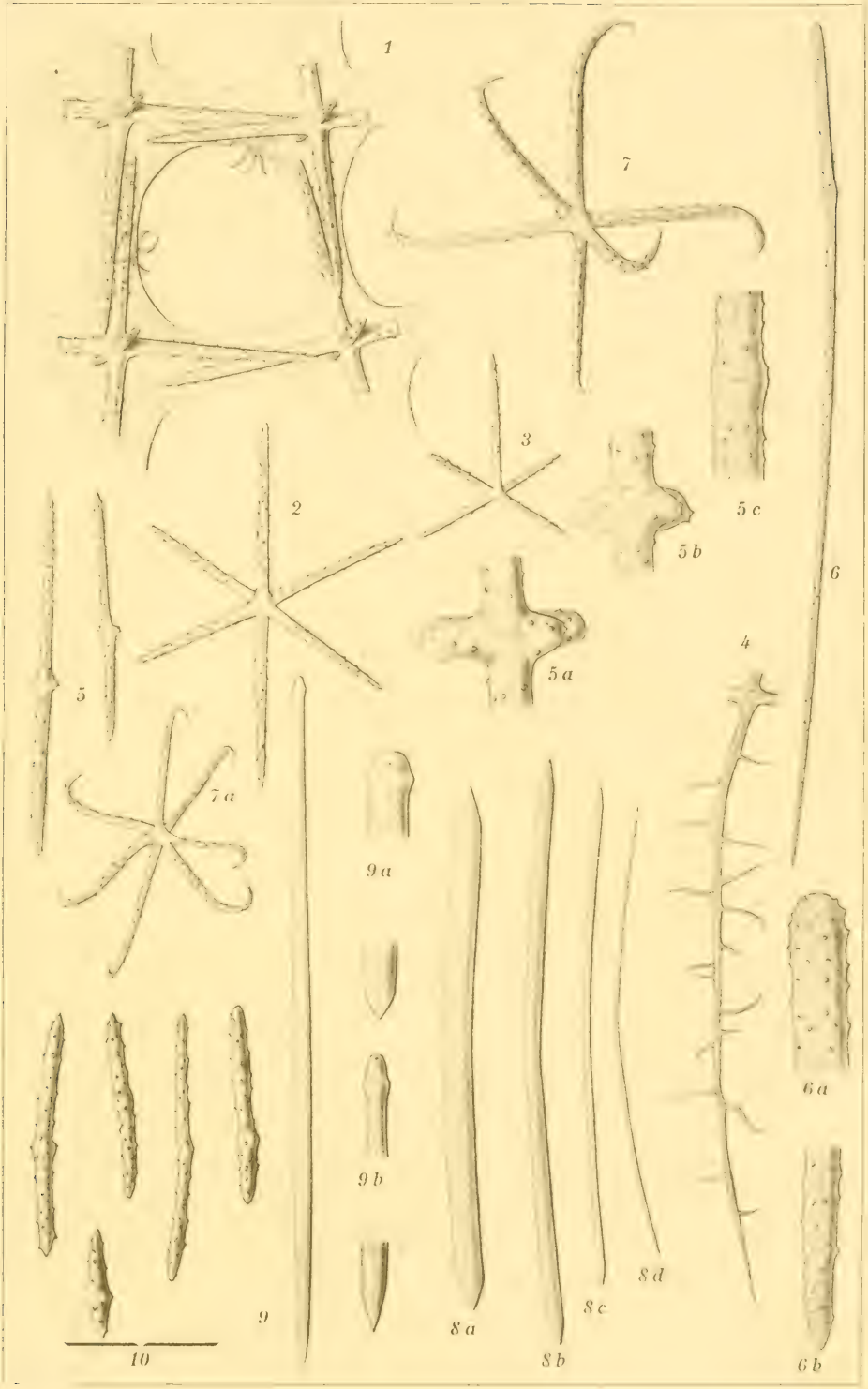
PLATE XXVI.

PLATE XXVI.

Figs. 1—7. *Rhabdocalyptus arcticus* nov. sp., p. 477.
Fig. 1. Gastral membrane with hexacts. × 90.
— 2. Oxyhexacts. × 90.
— 3. Oxypentacts from dermal membrane. × 225.
— 4. Tangential ray of prostalia pleuralia. × 50.
Figs. 5—5 c. Oxydiacts. fig. 5 × 130; figs. 5 a—c × 345.
— 6—6 b. Diact. fig. 6 × 50; figs. 6 a—b × 345.
— 7—7 a. Hexacts. × 405.

Fig. 8. *Halichondria tenuispiculata* nov. spec. pag. 479.
Figs. 8 a—d. Oxea, grown up and developmental forms. × 345.

Figs. 9—10. *Higginsia pyriformis* nov. spec. pag. 481.
Figs. 9—9 b. Tylostyles. fig. 9 × 130; fig. 9 a—b. × 405.
Fig. 10. *Minute oxea.* × 900.



Brøndsted del. Pacht & Crone phototyp.

XVIII.

THE ALCYONARIA OF EAST-GREENLAND

BY

HECTOR F. E. JUNGERSEN

Very little, next to nothing, has been published hitherto regarding the occurrence of Alcyonarians at the eastern and north-eastern coasts of Greenland. In 1874 Moebius mentioned *Briareum grandiflorum* Sars as taken by the second German North-Polar-Expedition 1869—70 (Die zweite Deutsche Nordpolarfahrt etc. Vol. II, p. 260); this statement, however, turns out to be wrong, the form in question being an *Eunephthya* (see below under *E. glomerata*). In 1904 I made known three different localities where *Umbellula encrinus* (L.) had been captured (Pennatulida Ingolf-Exped. p. 86—87). Nothing more is to be found in the literature. The occurrence, however, at Eastern Greenland of one or more of the widely distributed arctic species of the genus *Eunephthya* might at least seem extremely probable; and in fact specimens representing four species of this genus were several years ago handed over to the Zoological Museum of Copenhagen from Capt. Ryder's Expedition with the "Hekla" in 1891—92 and the Carlsbergfond-Expedition with the "Antarctic" in 1900. Besides, a single specimen of a *Virgularia* has been taken on the latter expedition, a fact unknown to me, when I worked out my report of the northern Pennatulida quoted above.

As the somewhat scanty material of the Danmark Expedition only contains four out of the six species of Alcyonarians already brought back by the previous expeditions mentioned, and as no account of this material has ever appeared, I take the opportunity now to enumerate in the following lines all the species hitherto found at Eastern Greenland, and the localities where they have been caught.

Alcyonacea.

Fam. *Nephthyidæ* Verrill.

Eunephthya rubiformis (Ehrenberg).

Lobularia rubiformis Ehrenberg: Corallenthiere des Rothen Meeres. 1834, p. 282.

Alcyonium rubiforme Dana: Zoophytes. Un. St. Explor. Exped. 1846, p. 625.

— — Verrill: Rev. Polyps East Coast Un. St. Mem. Boston Soc. N. Hist. Vol. I, 1864, p. 4.

Alcyonium rubiforme Verrill: Synops. Pol. and Cor. North Pacif. Expl. Exp. 1853—56. Proc. Essex Inst. Vol. IV, 1865, p. 190.

— — Verrill: Polyps and Echinod. New England. Proc. Bost. Soc. N. H., Vol. X, 1864—66, p. 355.

— — Verrill: Notes on Radiata No. 6. Review Cor. and Polyps W. Coast Am. Trans. Conn. Acad., Vol. I, 1868, p. 459.

— — v. Marenzeller: Poriferen etc. Die internat. Polarforschung 1882—83. Die oesterr. Polarst. Jan. Mayen, Vol. III, 1886, Zool., p. 15.

— — Jungersen: Karahavets Alcyonider. Dijmphna Togtets zool. botan. Udbytte 1887, p. 379, Pl. XXXII, Figs. 14—22.

Paraspongodes rubra May.: Alcyon. v. Ostspitzbergen. Zool. Jahrb. Syst. Abt., Vol. XI, 1898, p. 393, Figs. 3 a—b.

Alcyonium rubiforme (Ehrb.) + *Paraspongodes rubra* + *P. globosa* + *?P. uvæformis* May.: Die arkt. etc. Alc. fauna. Fauna arctica, Vol. I, 1900 p. 386, 400, 395.

Eunephthya rubiformis Kükenthal: Alcyon. Zool. Ergebn.... „Olga". Wiss. Meeresuntersuch. N. F. Vol. VIII. Abt. Helgoland, Hft. 1, 1906, p. 21.

— — + *?E. uvæformis* Kükenthal: Alcyon. Wiss Erg. Deutsch. Tiefsee-Exp. 1898—99 ("Valdivia"), Vol. XIII, 1906, p. 72.

— — Kükenthal: Versuch e. Revis. d. Alcyon. Fam. Nephthyidæ, 3. Zool. Jahrb. Abt. System., Vol. XXIV, 1907, p. 331, 335.

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— — Broch: Alcyon. d. Kolafjordes. Trav. Soc. Imp. Natur. St. Pétersbourg, Vol. XLI, 4, 1911, p. 5.

— — Broch: Coelentérés du Fond. Duc d'Orléans Camp. arct. de 1907, 1912, p. 19.

— — Broch: Arkt. Alcyon. Tromsø Mus. Tromsø Mus. Aarshft. XXIV, 1913, p. 179.

Mr. FRITZ JOHANSEN, Zoologist to the Danmark Expedition, has taken with an algæ-dredge, in the Hydroid-region, among stones and shells of *Balanus*, 8 specimens; two of these are large, the largest measuring more than 50 mm. in height, ca. 35 mm. across the broadest part, with about 40 contracted, rounded branches, and a short, broad stem; the smaller ones are from 7 to 12 mm. high. The colour of

the living colony is stated by Mr. JOHANSEN to be "wine-red, the stem brownish.". Now the colour, as usual with this species when preserved in spirit, is uniform red or pink (the colour in this species is due to red spicules, which keep their colour like those of f. inst. *Corallium*, *Gorgonia pinnata*, *Pennatula phosphorea* etc., while all other arctic species of *Eunephthya*, possessing colourless spicules, either completely lose their colour in alcohol or show a uniform yellowish or greyish or brownish hue, more or less intense).

Locality: S. of Cape Bismarck: St. 95 and 95 a, the sound between "Renskær" (76°41′ N) and "Maatten" (76°42′ N), 25—50 fthms.; $^{19}/_{7}$ 1908.

The late S. JENSEN, Zoologist to the Carlsbergfond-Expedition, has taken this species at the following places, farther south in East-Greenland: Hurry Inlet (70°50′ N), 50 fthms., clay with stones; $^{11}/_{8}$ 1900 (2 small colonies on shells of *Arca glacialis*); Henry Land (69°34′ N), 20 fathoms, stones and algæ; $^{21}/_{7}$ 1900 (2 specimens, the one fairly large); Tasiusak (65°37′ N), 25—30 fthms.; $^{3}/_{5}$ 1899 (a single large colony, ca. 50 mm. high).

E. rubiformis is widely distributed in arctic regions; it seems to be circumpolar, but hitherto it is not known from the greater part of Arctic N. America nor from the N. Asiatic region east of the New Siberian Islands, where — as far as I know — no thorough investigations have been carried on, or from which at least nothing has been published. It is mainly littoral or occuring in shallower parts of the open sea, ranging from 15 to 180 fathoms, and is often found where the bottom temperature is below zero. It has not been found at the coasts of Iceland or in Danmark Strait, nor in Baffin Bay and Davis Strait or at the coasts of Western Greenland. At the eastern coasts of N. America it passes the arctic regions, having been found at New Foundland and off Maine (Eastport). Actually it is known from the following regions outside Eastern Greenland: Jan Mayen, Spitsbergen, Barents Sea, Novaya Zemlya, Kara Sea, off the northern coast of Siberia including the New Siberian Islands; Bering Strait and Arctic Ocean north of Bering Str.; eastern part of the Murman-Sea, Kola-Fjord and Porsanger Fjord (but in no other fjord of Norway); further, on the American side, at the northern coasts of Jones Sound (north of 76° N. L.), at New Foundland and Maine.

Eunephthya fruticosa (M. Sars, emend. Jungs.).

Alcyonium sp. Naturhist. Tillæg til Rink's Grønland Vol. II, 1857, p. 105, No. 6.

— *fruticosum* Mich. Sars: Bem. over norske Coelenterater. Forh. Vid. Selsk. Christiania 1860, p. 140.

Alcyonium sp. Lütken: Manual of the N. Hist. etc. Ed. R. Jones, 1875, XX, p. 186, No. 11.

— *fruticosum* Koren and Danielssen: Nogle nye norske Coelenterater. Fauna littor. Norvegiæ, Vol. III, 1877, p. 81, Pl. III, Figs. 8—11.

Gersemia florida + *?G. loricata* v. Marenzeller: Coelent., Echinod. etc. österr.-ung. Nordp.-Exp. Denkschr. Ak. Wiss. Wien, Vol. XXXV, 1878, p. 375, 377, Pl. III, Figs. 2—3.

? — — Carter in list p. 259 of D'Urban: Zoology of the Barents Sea. Ann. Mag. N. H. (5), Vol. VI, 1880, p. 253.

? — *longiflora* Verrill: Res. expl. St. "Albatross" etc. U. S. Comm. Fish and Fisheries. Rep. 1883 (1885), p. 513, 533, Pl. II, Fig. 13; and: Rep. Anthozoa... "Blake" and "Fish Hawk". Bull. Mus. Comp. Zool., Vol. XI, 1883, p. 44, Pl. III, Fig. 6.

— *danielssenii* v. Marenzeller: Porif., Anthoz. etc. Die intern. Polarf. 1882—83. Die österr. Polar. Jan Mayen. Vol. III, 1886, p. 16.

Voeringia fruticosa + *V. arborea* Jungersen: Kara Havets Alcyonider. Dijmphna Togt. zool.-bot. Udbytte, 1887, p. 375, 378, Pl. XXXII, Figs. 1—13, Pl. XXXIII, Figs. 1—12.

— *mirabilis* + *V. fruticosa* + *V. abyssicola* + *V. polaris* + *V. pygmæa* + *V. dryopsis* + *V. Jan Mayeni* + *V. clavata* + *V. capitata* + *Barathrobius digitatus* + *B. palmatus* + *Krystallofanes polaris* + *Fulla Schiertzii* + *Nannodendron elegans* + *Nidalia arctica* + *Organidus Nordenskiöldii* + *Sarakka crassa* + *?Sympodium abyssorum* Danielssen: N. Nordhavs Exped. Alcyonida, 1887, p. 1—35, 69—81, 104—137, 141; Pl. I, II, Figs. 1—41, Pl. VII, Figs. 45—47, VIII, IX, X, XV, Figs. 14—70, XVI—XXI, XXII, Figs. 67—63, XXIII.

Paraspongodes fruticosa + *P. glacialis* + *P. clavata* + *P. capitata* May: Alcyon. Ost-Spitzbergen. Zool. Jahrb. Syst. Abt., Vol. XI, 1898, p. 388—97, Pl. XXIII, Figs. 1—2, 4.

— — + *mirabilis* + *P. caduca* + *P. abyssicola* + *P. clavata* + *P. capitata* + *P. griegi* + *Sympodium abyssorum* + *Organidus Nordenskiöldi* + *Nidalia arctica* + *Krystallofanes polaris* + *Sarakka crassa* May.: Die arkt. etc. Alcyon. Fauna arctica, Vol. I, 1900, p. 388, 394, 395, 396, 398, 384, 385, 386, 387.

Paraspongodes clavata Studer: Rés. Camp. scient. Pr. de Monaco. Alcyonaires ... de l'Hirondelle, Vol. XX, 1901, p. 31.

Eunephthya — + *E. fruticosa* + *E. mirabilis* + *Nidalia arctica* (+ *Krystallofanes* + *Sarakka*) Kükenthal: Alcyonacea. Wiss. Erg. D. Tiefsee-Exp. 1898—99 ("Valdivia"), Vol. XIII, 1906, p. 73, 74, 37 (26).

— — + *E. fruticosa* + *E. mirabilis* + *Gersemia arctica* + *G. crassa* + ?*G. loricata* Kükenthal: Vers. e. Revis. d. Alcyon. 3, II, Fam. Nephthyidæ. Zool. Jahrb. Abt. Syst. Vol. XXIV, 1907, p. 336, 339, 345, 386.

— *fruticosa* Broch: Duc d'Orléans. Croisière océanogr.... Belgica 1905 (1907), p. 532.

— *clavata* + *E. fruticosa* Kükenthal: Alcyon. Zool. Erg... "Olga" 1898. Wiss. Meeresunt. etc. N. F. Vol. VIII. Abt. Helgoland, Hft. 1, 1906 (1908), p. 23, 25, Pl. I, Fig. 2, Fig. 5.

— *fruticosa* + *E. mirabilis* + *E. clavata* + ?*Gersemia loricata* Kükenthal: Zur Kenntn. der Alc. d. Sibir. Eism. Mém. Ac. Imp. Sc. St. Pétersb. (8), Vol. XVIII, No. 15, 1909, p. 5, 6.

— *clavata* + *E. fruticosa* + *E. mirabilis* Broch: Coelentér. du Fond. Duc d'Orléans Camp. arct. 1907. 1912, p. 19, 21.

— — + *E. fruticosa* Broch: Alcyon. Kolafjordes. Trav. Soc. Imp. Nat. St. Pétersb. Vol. XLI, 1911 (1912), p. 8, 10.

— — + *Gersemia loricata* Broch: Alc. Trondhjemsfj. K. Norske Vid. S. Skr. 1911, No. 7 (1912), p. 36, 44.

— *fruticosa* + *G. loricata* + *G. abyssorum* Broch: Arkt. Alc. Tromsø Mus. Tromsø Mus. Aarshefter, Vol. XXXIV, 1913, p. 180, 181.

The reasons why I have united into one species of *Eunephthya* the many "genera" and "species" established by previous authors and named in the above list of synonyms, will be set forth in my account of the Alcyonarians etc. of the Ingolf-Expedition, now in preparation. Here I only wish to state that I quite agree with KÜKENTHAL as to the great reductions already made by him after careful examination of a vast material, including most of the original specimens which served previous authors for investigation and determination; having myself, however, examined not only most of the same

original specimens but, besides, a still larger — in fact an extremely large — material from the greater part of the distributional area of the northern representatives of the genus *Eunephthya*, I feel convinced that a further reduction is needed, as no tangible differences are to be found which might really separate and characterize several forms still maintained by KÜKENTHAL. For all these forms which insensibly pass into each other by every structural degree I have kept the oldest specific name, given by MICHAEL SARS in 1860.

Most of the specimens in hand from Eastern Greenland are rather small and contracted, showing the shape of "*forma clavata*", while some are more or less "*Gersemia*"-like; only two large specimens, with most of the polyps fully protruded, belong to the "*forma fruticosa*".

The Danmark Expedition has provided this species from the same locality as the preceding: St. 95, the sound between "Renskær" and "Maatten", 25 fthms.; 19/7 1908 (three small specimens, more or less "*Gersemia*"-like).

RYDER's Expedition: Entrance to Scoresby Sound (probably at Cape Hooker: 70°28′ N., 23° W.), 10—65 fathoms, 3/8 1891 (three small colonies, taken with swabbers; "*forma clavata*", polyps mostly expanded).

Carlsbergfond Expedition (S. JENSEN): Hurry Inlet (70°50′ N.), 50 fthms., 11/8 1900 (three loose colonies, of which two large, measuring in height 55 and 65 mm, of the "*forma fruticosa*"; 15 mostly small — some simply single polyps — of "*forma clavata*", fixed on shells of *Arca glacialis*).

This species probably is circumpolar but by no means only arctic, its distribution comprising also the boreal part of the Atlantic, perhaps reaching as far south as the Azores (STUDER, "l'Hirondelle" 1887), and on the American side to off Delaware Bay (if the identity with *Gersemia longiflora* Verrill proves to be correct). From the greater part of the arctic North-American seas it is not known hitherto, nor from the Siberian Polar Sea, east of the estuary of the Lena. Otherwise it is known from the coasts and fjords of Western Greenland — from Jakobshavn to Bredefjord —; from Baffin Bay and Davis Strait; from the northern coast and fjords of Jones Sound; from Danmark Strait; round Iceland, Jan Mayen, Spitsbergen, Beeren Eiland, Franz Joseph Land, Barents-Sea, Murman Sea, Kara-Sea and along the Siberian coast to the mouth of the Lena; further in the Kola-fjord, the Norwegian fjords from Varanger- to Stavanger-fjord and in the North Atlantic between Norway, the Færoes and Iceland as well as farther north in the open sea of the arctic regions. Thus it is by no means littoral, its bathymetrical distribution ranging

from ca. 10 to 1300 fthms.; and it occurs in the deep and cold polar basin as well as in bottom temperatures above zero.

Eunephthya glomerata (Ltk. M. S.) Verrill.

Nephthya sp. aff. *N. florida* (Rathke): Nath. Tillæg Rink's Grld. Vol. II, 1857, p. 105, No. 7.

Eunephthya glomerata Verrill: Critic. Rem. on Halcyonid Polyps. Am. Journ. Sc., Vol. XLVII, 1869, p. 284; and: Proc. Essex Inst., VI, 1869, p. 97.

Briareum grandiflorum Moebius: Die zweite deutsche Nordpolarfahrt etc. Vol. II, 1874, p. 260.

Ammothea arctica Lütken: Manual of the N. H. etc. Greenl. Ed. R. Jones, 1875, p. 186, No. 10 (only name).

— — Norman: Biol. Valorous Cruise, 1875. Pr. R. Soc. Ld., Vol. XXV, 1876, p. 208.

— *Lütkeni* v. Marenzeller: Coel. etc. K. K. oesterr.-ung. Nordp.-Exp. Denkschr. Ak. Wiss. Wien. Vol. XXXV, 1878, p. 372, Pl. III, Fig. 1.

Alcyonium Lütkeni Verrill: Notice rec. add. to mar. Invertebr. etc. Pr. U. S. Nat. Mus., Vol. II, 1879, p. 200.

Ammothea glomerata Carter, p. 269 and 259 in: D'Urban, Zoology of the Barents Sea. Ann. Mag. N. H. (5), Vol. VI, 1880, p. 253.

Gersemia candida Koren and Danielssen: Nye Alcyonider etc. Bergens Museum 1883, p. 9, Pl. V, Figs. 1—15.

Ammothea arctica Lütken in Wandel: En Fremst. af vort Kjendsk. til Grønlands Østkyst etc. Medd. om Grønland, Vol. VI, 1883, p. 29.

Eunephthya Lütkeni Verrill: Rep. Anthoz. . . . "Blake" etc. Bull. Mus. Comp. Zool. Harvard Coll., Vol. XI, 1883, p. 43, Pl. IV, Fig. 7.

Ammothea Lütkeni v. Marenzeller: Porif. etc. Die intern. Polarf. 1882—83. Die oesterr. Pol. St. Jan Mayen. Vol. III, 1886, p. 16.

Nephthya polaris + *N. flavescens* + *N. rosea* + *Drifa islandica* + *D. hyalina* + *Gersemiopsis arctica* Danielssen: N. Nordhavs-Exp., Vol. V, Alcyon. 1887, p. 92, 83, 87, 65, 59, 99; Pl. VI, VII, XI—XV.

Paraspongodes polaris May: Alcyon. v. Ost-Spitzbergen. Zool. Jb. Abt. Syst. Vol. XI, 1898, p. 397.

— *lütkeni* + *P. polaris* May: Beitr. z. System. etc. Jen. Zeitschr. Nat. Vol. XXXIII, 1899, p. 148, 154.

Paraspongodes lütkeni + *P. sarsi* May: Die arkt. etc. Alc. faun. Fauna arctica, Vol. I, 1900, p. 398, 399.

Eunephthya glomerata + *E. hylina* Kükenthal: Alcyonacea. Wiss. Erg. d. deutsch. Tiefsee-Exp. ("Valdivia"), Vol. XIII, 1906, p. 78, 79.

— — + *E. hyalina* Kükenthal (Versuch e. Revis. d. Alcyon. Fam. d. Nephthyid. 3. Zool. Jb. Abt. System. etc. Vol. XXIV, 1907, p. 351, 358.

— — Kükenthal: Alcyon. d. "Olga"-Exp. Wiss. Meeresunt. etc. N. F. Vol. VIII. Abt. Helgoland. Hf. 1. 1906, p. 26.

— — Thomson: Note on *E. gl.* from the Færoe Channel. Proc. R. Phys. Soc. Edinb., Vol. XVIII, 1910, p. 95.

— — Broch: Die Alcyonaceen d. Kolafjordes. Trav. Soc. Imp. Nat. de St. Pétersbourg, Vol. XLI, 1911 (4), p. 12.

— — Broch: Coelentérés du Fond. Duc d'Orléans Camp. arct. de 1907. 1912, p. 21.

Like the preceding two species *E. glomerata* has been taken by the Danmark Expedition on St. 95, the sound between "Renskær" and "Maatten", 25—50 fthms., $^{19}/_{7}$ 1908 (6 specimens, the largest ca. 40 mm. high, 25 mm. where broadest, the smaller colonies 11—15 mm. high); further on St. 15 (76°35′ N, 18°26′ W, off "Sonja Harbour", i. e. off the southern end of Little Koldewey), 150 M., stones and pebbles (Delesseria-region), $^{14}/_{8}$ 1906. The journal of Mr. JOHANSEN adds: "among ice-flakes", and that a square dredge was used for half an hour (2 small colonies, ca. 4—5 mm. high, on a stone). The colony in the living state is said to be: "polyps pink, stem brown"; in spirit these colours have faded completely away.

The Carlsbergfond Expedition: Tasiusak (65°37′ N), 26—30 fthms., $^{23}/_{5}$ 1899 (4 specimens of medium size, 20—25 mm. high); Henry Land (69°34′ N), 20 fthms., among stones and algæ, $^{21}/_{7}$ 1900 (3 large colonies, 40—50 mm. high); Cape Tobin (northern side of entrance to Scoresby Sound, 70°23′ N, ca. 22° W), 57 fthms., clay with stones (beam-trawl), $^{21}/_{8}$ 1900 (2 specimens 37 mm. high); Hurry Inlet (70°50′ N), 50 fthms., $^{11}/_{8}$ 1900 (a single colony 30 mm. high). Once more the species has been taken at Tasiusak (65°35′ N) by Mr. KRUUSE, 30—50 fthms., $^{23}/_{8}$ 1902.

To the above localities has to be added: Shannon Island (ca. 75°25′ N.), a few specimens on *Hornera lichenoides* Lin., the largest one ca. 18 mm. high, provided by the second German N. Polar Expedition 1869—70. As already mentioned MOEBIUS in his report on the Mollusca, Echinoderms and Coelenterata of this expedition (l. c.

p. 260) notes this find as "*Briareum grandiflorum* Sars". The occurrence, however, in decidedly arctic surroundings, at the high latitude of 75°, of an Alcyonarian otherwise only known from the warm area of the Atlantic must seem at least very improbable; and already Lütken evidently suspected the determination to be wrong, since he in the "Manual etc." under his "*Ammothea arctica* M. S." — although with a query — quotes "*Briareum grandiflorum* Moebius" as a synonym. To settle the question I asked Professor Brandt in Kiel for permission to examine the original specimens of Moebius, and he kindly sent them to me. In spite of their extremely bad preservation they were easily and without the least doubt recognized as *Eunephthya glomerata*.

Like the preceding species *E. glomerata* is widely distributed, probably circumpolar, arctic as well as boreal. It is, however, not known off the Siberian coast east of the Kara Sea nor in the greater part of the N. American arctic seas. It has been found at the northern coast of Jones Sound, in Smith Sound[1], in Baffin Bay and Davis Strait, and at the western coasts of Greenland from Jakobshavn to Bredefjord; along the east coast of N. America from N. Scotia to Delaware Bay (38°16′ L. N.); in Danmark Strait, round Iceland, Jan Mayen, Spitsbergen, Beeren Eiland; in the Barents Sea, the Kola-Fjord, round Novaya Zemlya; further in the North Atlantic and in some of the Norwegian Fjords between Nordfjord and Varangerfjord. It occurs in bottom temperatures below as well as above zero, and ranges from littoral regions to great depths in the open sea — from c. 10 to at least 800 fathoms (1497 fthms, Verrill).

Eunephthya florida (Rathke).

Gorgonia florida Rathke: Zoologia Danica. Vol. IV, 1806, p. 20, Pl. 137.
Nephthya Rathkiana Ehrenberg: Die Corallenthiere des Rothen Meeres, 1834, p. 61.
— — (*Gorgonia florida* Rthk.) Storm: Bidr. Kundsk. Throndhjemsfj. Fauna. Kgl. N. Vid. Selsk. Skr. 1878, [1879] p. 23.
Alcyonium multiflorum Verrill: Notice rec. add. Mar. Invertebrata etc. Proc. U. S. Nat. Mus., Vol. II, 1879, p. 200.
Duva rosea + *D. pellucida* + *D. pulcra* + *D. florida* Koren and Danielssen: Nye Alcyon. etc. Bergens Mus., 1883, p. 1—7, Pl. I—III.
— *arborescens* + *D. aurantiaca* + *D. frigida* + *D. glacialis* + *D. spitsbergensis* + *D. violacea* + *D. flava* + *D. cinerea* Danielssen: Alcyon. Norske Nordh.-Exp. 1887, p. 37—59; Pl. III—V, VI, Figs. 1—29.

[1] Teste Carter l. c. p. 70.

Paraspongodes rosea + *P. pellucida* + *P. pulcra* + *P. arborescens* + *P. aurantiaca* + *P. frigida* + *P. glacialis* + *P. spitsbergensis* + *P. violacea* + *P. flava* + *P. cinerea* + *P. florida* + *P. caduca* May: Die arkt. etc. Alc. fauna. Fauna arctica. Vol. I, 1900, p. 391—94.

— — Nordgaard: Hydrograph. und Biol. Investig. in Norw. Fjords, 1905, p. 158.

Eunephthya rosea — *E. spitzbergensis* + *E. florida* Kükenthal: Alc. Erg. d. D. Tiefsee-Exped. ("Valdivia"), Vol. XIII, 1906, p. 79—81 and: Vers. e. Revision d. Alcyon. etc. Zool. Jb. Abt. System. etc., Vol. XXIV, 1907, p. 361, 366, 374; and *E. rosea*, var. *umbellata*: Zool. Erg.... "Olga". Alcyon. Wiss. Meeresunt. etc., N. F., Vol. VIII, 1906. Abt. Helgoland, p. 26, Pl. I, Figs. 3, 6.

— — Hickson and Stephens: Alc. and Madrep. Cor. of the Irish Coasts. Fisheries, Ireland, Sc. Inv. 1907, V (1909), p. 5.

— *florida* Broch: Alcyon. d. Kolafjordes. Trav. Soc. Imp. Natur. de St. Pétersbourg, Vol. XLI, 1911, p. 14.

— — Broch: Die Alcyon. d. Trondhjemsfjordes. 1 Alcyon. K. N. Vid. Selsk. Skr. 1911, No, 7, p. 39.

— — Broch: Arkt. Alc. Tromsø Mus. Tromsø Mus. Aarshft., Vol. XXXIV, 1913, p. 181.

As will be seen from the list of synonyms I quite agree with BROCH (l. c. 1911 p. 43) in joining together the three forms which KÜKENTHAL kept separate in his group "*Umbellata*", with the suggestion, however, that they possibly later might be united into one species, an opinion which also HICKSON (l. c. 1907, p. 6) seems to share. That in this case the specific name must be that given by RATHKE needs no further justification.

E. florida has only been taken by the Carlsbergfond Expedition, and at the following localities: Turner Sound (69°45′ N, 23°20′ W), 3 fthms. $^{25}/_{7}$ 1900 (a single small specimen); Cape Tobin (at the northern side of the entrance to Scoresby Sound, 70°23′ N, ca. 22° W), 57 fthms., $^{21}/_{8}$ 1900 (2 well sized colonies, resp. 65 mm. and 50 mm. high).

This species seems to be arctic as well as boreal, but according to the facts hitherto known its geographical distribution is considerably more restricted than that of any of the preceding species, no specimens having been taken east of the Kolafjord nor in any part of the N. American arctic archipelago; it therefore seems doubtful, if the species really should turn out to be circumpolar.

At the western coasts of Greenland it has only been found in one of the southernmost fjords, viz. Bredefjord, but in the open sea off Western Greenland, Baffin Bay and Davis Strait, it has been captured at several points between 70°42′ N and 63°30′ N and out to 55°54′ Long. W.; further it has been found in Danmark Strait, off the northern coast of Iceland, at Spitsbergen; in the North Atlantic south and east of Iceland, round the Færoes, and off Norway; in some of the Norwegian Fjords from Nordfjord to Øxfjord, and in the Kolafjord; the southernmost locality hitherto recorded is off Achill Head, Western Ireland.[1]

The depth mentioned above for Turner Sound — 3 fathoms — seems to be the lowest bathymetrical limit observed, while the maximum depth lies between 600 and 700 fathoms; like the preceding species it may be found where the bottom temperature is above or below zero.

Pennatulacea.

Fam. *Virgulariidæ* Kölliker (emend. Jungersen 1904).

Virgularia affinis Koren & Danielssen.

Virgularia affinis Koren M. S. (name given by Koren 1855 in labelling the first specimen found in the Varangerfjord and preserved in the Museum in Bergen).

— *glacialis* M. Sars M. S. (only on labels in the Museums of Christiania and Copenhagen on specimens found 1857 at Vadsö, Varanger Fjord).

— — Kölliker: Die Pennatuliden. Abhdl. d. Senckenbergisch. Naturf. Gesellsch. Bd. VII, VIII, 1872, p. 198, Pl. XIII, Figs. 116, 117.

— *Steenstrupii* Kölliker, ibid. p. 199, Pl. XVI, Figs. 128, 129.

— *affinis* Koren & Danielssen: Contrib. to the natur. hist. of the Pennatul. living on the Norwegian coast. Fauna littoralis Norvegiæ. Vol. III, 1877, p. 90, Pl. IV, Figs. 1—7.

— — Grieg: Oversigt over Norges pennatulider. Bergens Mus. Aarsberetning 1891, No. 1, p. 11.

[1] The *"Alcyonium multiflorum"* described by Verrill (Proc. U. S. Nat. Mus., 1879, p. 200, and mentioned again in Rep. U. S. Comm. Fish and Fisheries 1883 (1885) p. 533), seems to be identical with *E. florida.* Granted the correctness of this identification — of which I have not the least doubt — the known distribution of *E. florida* in the western part of the N. Atlantic extends from Baffin Bay to off the N. American east coast, at least to 44°06′ Lat. N.

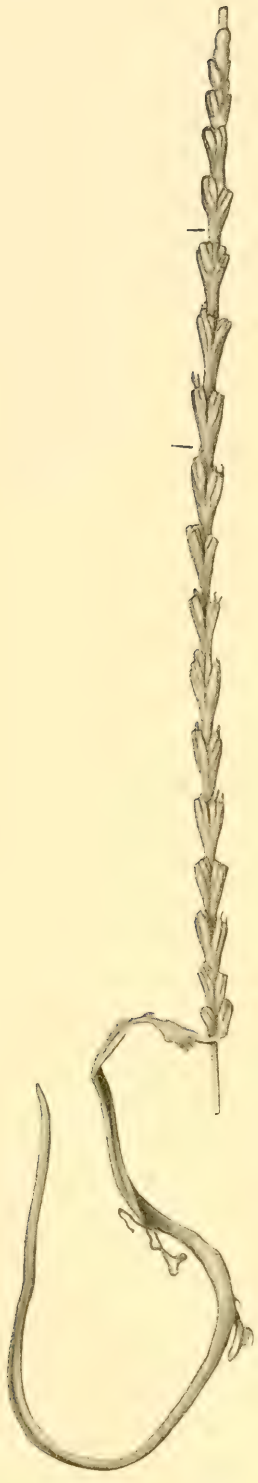


Fig. 1. *Virgularia affinis* K. & D. Young specimen from Canning Land. Ventral aspect. × ca. 5.

Virgularia affinis Kükenthal & Broch: Pennatulacea. Wiss. Erg. d. Deutsch. Tiefsee-Expedition 1898—99 ("Valdivia"), Vol. XIII, 1911, p. 336.

A single specimen was caught on the Carlsbergfond Expedition by Mag. sc. SØREN JENSEN at Canning Land (71°30′ N, 21°55′ W), 202 fathoms, 1/9 1900.

It is a young colony, broken just below the polyp-bearing part of the rhachis; the soft parts below the fracture are, however, still adherent but badly damaged and without any calcareous axis. The total length is — approximately — 123 mm., the breadth across a pair of opposite wings in the middle of the rhachis c. 2 mm.; the diameter of the rhachis between the wings ca. 0,8 mm.; ca. 17 sets of wings are preserved, the upper ones, as usual in the genus *Virgularia*, rudimentary towards the naked end of the calcareous axis; the number of polyps in each wing mostly 4; the polyps of each wing coalesced to the calyx openings, which are toothless; the lines of attachment of each wing very oblique; the opposite wings are in contact along the mid-ventral line of the rhachis; zooids few, scattered in the diastemes between the wings, not visible from the dorsal face of the rhachis; the radial canals on this side form a longitudinal swelling along the rhachis.

In spite of the damaged condition the single series of "stalk-zooids", characteristic of the genus *Virgularia*, is plainly visible with a strong lens.

The facts mentioned, as well as the figures, clearly show this specimen to belong to the genus *Virgularia*; only as to the species some doubt might be entertained. At first I thought to have before me a new species, but very nearly related to *V. affinis*.

Closer examination, however, revealed to me no essential differences from the latter which might not be explained by the youthful age of the specimen; and in fact comparison with a complete, young, specimen of about the same size of *V. affinis* in the Bergen Museum, preserved among a lot of larger and large ones taken by G. O. Sars at Vadsø, has removed my last doubts as to the correctness of referring the East-Greenland specimen to the same species.

In clearing this specimen with glycerine — otherwise leaving it intact as the only document of the occurrence of the species at Greenland — I have been able to state the presence, in the inner soft parts of the stalk, of minute spicules like those of other species of *Virgularia*; and in examining the extremity of the stalk of a specimen from Varangerfjord, preserved in our Museum (the type specimen of Kölliker's *V. Steenstrupii*), I found the same minute calcareous bodies. Thus the question, left open by Kükenthal and Broch as to the presence or absence of these spicules, now is settled.

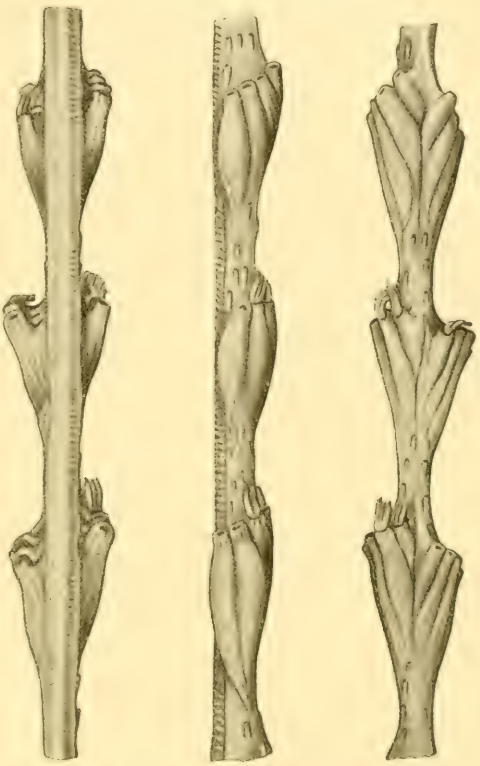


Fig. 2. Part of rhachis of the same specimen (between the two markings in Fig. 1); dorsal, lateral and ventral aspect. × ca. 7.

The occurrence of this species at Eastern Greenland is a fact of some interest. Hitherto it has only been found at different places in the Varangerfjord, especially at Vadsø, in depths of 60—100 fathoms. Grieg, however, adds (l. c. p. 11) that it has been found besides in the Trondhjemsfjord and in the Bergensfjord, a specimen from the latter locality being preserved in the Museum at Stockholm; and G.'s statements are repeated by Kükenthal and Broch (l. c. p. 337). But later Broch (Alcyon. Trondhjemsfj. III, Penn. K. N. Vid. S. Skr. 1912, No. 10 [1913], p. 25) declares that the occurrence in the Trondhjemsfjord has not been proved, and that this species therefore, for the present, has to be withdrawn from the fauna of that fjord. The specimen said to be from Bergensfjord has kindly been lent to me for inspection by

Prof. THÉEL, Director of the Riksmuseum at Stockholm; it turned out that every probability points towards Varangerfjord as its real home[1].

Thus, so far, this species is only recorded from two widely separated areas north of the polar circle, which areas may have in common certain hydrographical features, f. inst. a certain amount of temporary oscillation of cold and warm bottom temperatures, features the probability of which I only venture to suggest, as I have no positive knowledge about the real facts.

Fam. *Umbellulidæ* Kölliker.

Umbellula encrinus (L.).

Isis encrinus Linné: Systema naturæ Ed. X, 1758, p. 800.
Pennatula encrinus Pallas: Elenchus Zoophytorum, 1766, p. 355.
Vorticella encrinus Linné: Syst. nat., Ed. XII, 1767, p. 1317.
Ombellula Cuvier: Tableau élémentaire de l'hist. nat., 1798, p. 675.
Umbellularia groenlandica Lamarck: Animaux sans vertèbres. Ed. I, Vol. II, 1801, p. 436.
Umbellula encrinus + *U. miniacea* + *U. pallida* Lindahl: Om Pennatulidslägtet Umb. Cuv. K. Sv. Vetensk. Ak. Hdlg., Vol. XIII, 1874, No. 3, Pl. I—III.
— *Lindahli* Kölliker: Die Pennatulide Umbellula u. zwei. n. Typen d. Alcyonaria. Festschr. z. Feier d. 25 jähr. Best. d. Phys. Med. Ges. in Würzburg, 1874, p. 11.
— *encrinus* Lütken: Manual of the N. Hist. etc., XX, 1875, p. 186, No. 12.
— — v. Marenzeller: Die Coelent. etc. österr.-ung. Nordp.-exp. Denkschr. Ak. Wiss. Wien, Vol. XXXV, 1878, p. 377.

[1] No other information could be obtained than that of the label, running thus: "*Virgularia affinis.*
Bergen. Danielssen".
This of course does not prove that the locality is "Bergensfjord". In my opinion it simply means that this specimen has been acquired from Dr. DANIELSSEN, Bergen. Dr. D., of Bergen's Museum, had collected a lot of specimens in Varangerfjord 1857; and in 1877, in describing and figuring the species, he only gives this fjord as its home. Later he never mentions its occurrence anywhere else; and if nevertheless a single specimen should have been found in the immediate vicinity of Bergen, it must seem extremely improbable that the only proof of this occurrence should by D. himself be sent away to Sweden and not be preserved in the Bergen Museum, where he tried to store as complete a representation as possible of the marine fauna of Norway. Moreover the specimen in question is a fine and typically developed *Virg. affinis*, in every respect fully like other large samples from Varangerfjord, still kept in the Bergen collection.

Umbellula encrinus Danielssen and Koren: Pennatulida, N. Nordh.-Exp., 1884, p. 13, Pl. V—XII.

? — *Bairdii* Verrill: Not. rem. Mar. Faun. etc. No. 9, Am. Journ. Sc. Vol. XXXVIII, 1884, p. 219 (Note); and: Res. Expl. St. "Albatross" 1883 etc. U. S. Comm. Fish & Fisheries, Rep. 1883 (1885), p. 509, 533, Pl. I, Figs. 1—2.

— *encrinus* Stuxberg: Evertebratf. i. Sibir. Ishaf etc. Vega-Exp. vetensk. lakttt., Vol. I, 1882, p. 692; Vol. V, 1887, p. 163.

? — — Studer: Rep. dredg. Oper.... St. "Albatross" 1891. X. Note prélim. sur les Alcyon. Bull. Mus. Comp. Zool., Vol. XXV, No. 5, 1894, p. 57.

— Nathorst: Två somrar i Norra Ishafvet. Vol. II, 1900, p. 93 (cfr. The "Antarctic" in the Arctic. Nat. Science, 1899, p. 319).

— — Kolthoff: Till Spetsbergen och Norröstra Grönland År 1900, 1901, p. 176.

— — + *U. Lindahlii* Jungersen: Pennatulida. The Dan. Ingolf Exp., Vol. V, P. 1, 1904, p. 75, 79, Pl. III, Figs. 37—51.

? — — Roule: Not. prélim. Penn. recueillies par le "Travailleur" et le "Talisman" etc. Bull. Mus. d'Hist. nat., Vol. XI, 1905, p. 456.

— — + *U. Lindahli* (pro parte) Kükenthal and Broch: Pennatulacea. Wiss. Erg. d. D. Tiefsee-Exp. ("Valdivia") 1898—99. Vol. XIII, 1910, p. 285.

— — Balss: Not. ü. einige Penn. des Zool. Mus. d. K. Ak. Wiss. zu St. Petersburg. Ann. du Mus. zool. de l'Acad. Imp. d. Sc. d. St. Pétersbourg, Vol. XVI, 1911, p. 158.

— — + *U. Lindahli* Kükenthal: Zur Systematik d. Umbelluliden. Zool. Anz. Vol. XLIII, No. 13, 1914, p. 631.

The list of synonyms shows that I now unite *U. Lindahlii* with *U. encrinus*, while in my report on the Ingolf-Pennatulids I thought it convenient to distinguish two separate, although very closely related, species, the one characteristic of the "warm" the other of the "cold" area of the northern Ocean. Since the publication of the account mentioned I have had the opportunity to examine a large number of Umbellulas, old ones as well as young, from Greenland

waters, from the North Atlantic and from the Polar Sea; and I have been convinced of the impossibility of maintaining the above two as distinct species. Consequently the oldest specific name, given by LINNÆUS, has to be used for the northern *Umbellula.*

The occurrence of *Umbelllula encrinus* at Eastern Greenland has previously been stated (cfr. JUNGERSEN l. c. 1904, p. 86); now the Danmark-Expedition has added the following new locality: Off Maroussia (76°40′ N, east of Little Koldewey), 150 fathoms, mud with a little gravel, $^{22}/_{7}$ 1908. The single specimen, captured with a beam-trawl working for half an hour, is complete; the stalk is 420 mm. in total length, its bulbous part 60 mm. long, ca. 6 mm. in diameter where it is thickest, while the thinnest part of the stalk is less than 1 mm. in diameter; the length of the upper "sheath formed" dilatation is ca. 6 mm., that of the rhachis-club ca. 12 mm. The cluster contains 9 polyps, two of which still undeveloped; the body of the longest polyp measures about 12 mm, with tentacles ca. 27 mm. in length. Thus this specimen is a young one; it is more slender than any of the specimens described as *U. encrinus* in my account of the Ingolf Pennatulids, and the tentacles are much longer in proportion to the body of the polyps; in which respects it agrees with several specimens among a large number of *Umbellulæ*, captured in the Umanakfjord in 1908 by the "Tjalfe".

The East-Greenland localities formerly published are: Cape Brewster (70°9′ N, 22°5′ W, on the southern side of the entrance to Scoresby Sound), 250 fthms.; Canning Land (71°30′ N), 202 fthms. (Carlsbergfond Exped. 1900); entrance of Franz Joseph Fjord (73°20′ N), 200—300 M. (KOLTHOFF, 1900).

U. encrinus is known from the Arctic Sea and the nearest subarctic parts of the North Atlantic, viz.: Baffin Bay and the Umanakfjord (here in great numbers), Davis Strait; Danmark Strait; between East Greenland and Spitsbergen, at Spitsbergen, Jan Mayen, north and north-east and east of Iceland; between the Færoes and Norway; in the Færoe-channel; east of Franz Joseph Land, and in the Kara Sea.

If the species really — as indicated by some authors (J. STEPHENS: Alcyon. etc. of the Irish Coasts p. 21, ROULE: Bull. Mus. d'Hist. nat. Vol. XI, 1905, p. 416) — is distributed far south in the Atlantic — to off Marocco — seems to me extremely doubtful; and the same may be said regarding its occurrence in the Pacific, near the Galapagos Islands (STUDER: Bull. Mus. Comp. Zool. XXV, 1894, p. 57); cfr. my remarks in Conspectus Fauna Groenlandicæ. Alcyon. etc. Medd. Grønld. Vol. XXIII. Inside the area mentioned above, this

species has been found in depths from 122 to ca. 700 fathoms, but apparently reaching its maximum — and really gigantic — development in comparatively shallow water (i. e. 200—300 fthms.), where the bottom temperature remains constantly below zero or oscillates round the freezing point (as in the Umanakfjord). In depths surpassing 700 fthms. hitherto only quite young stages have been found.

Novbr. 1915.

16.—5.—1916.

XIX.

ACTINIARIA AND ZOANTHARIA OF THE DANMARK EXPEDITION

BY

OSKAR CARLGREN

Actiniaria.

Fam. *Cribrinidae.*

Urticina (Rhodactinia, Tealia) davisii (Agass.).

Locality: The sound between Maatten and Renskær St. 95. 25—50 fthm. 15. 7. 1908. Hydroid region. Several specimens.

Fam. *Paractidae.*

Anthosactis jan mayeni Dan.

Locality: 76°6′ N. B. 13°26′ W. L. St. 104 b. 100—125 fthm. Clay and gravel. 28. 7. 1908. 1 specimen.

Fam. *Actinostolidae.*

Actinostola spitsbergensis Carlgr.

Locality: The sound between Maatten and Renskær 25—50 fthm. St. 95. 19. 7. 1900. Hydroid region. Several specimens.

Fam. *Sagartidae.*

Chondractinia nodosa (Fabr.) Lütk.

Localities: Stormbugt off Baadskæret 20 fthm. St. 66. 28. 8. 1907. 1 specimen. Danmarks Havn 10—15 fthm. St. 67. 29. 8. 1907. Delesseria region. 1 specimen. "Øresund" 10—15 fthm. St. 71 b. 5. 9. 1907. Delesseria region. 1 specimen. Stormbugt 8—10 fthm. St. 72. 9. 9. 1907. Delesseria region. 1 specimen. The sound between Maatten and Renskær 25—50 fthm. 19. 7. 1908. Hydroid region. Several specimens.

Zoantharia.

Epizoanthus lindahli Carlgr.

Locality: 77°N.B. 17,5°W.L. 304 m. St. 99. 22. 7. 1908. 1 colony.

XX.

THE MARINE CARBONIFEROUS OF NORTH-EAST GREENLAND AND ITS BRACHIOPOD FAUNA

BY

KARL A. GRÖNWALL.

1916.

I. Introduction.

Among the most important discoveries of the "Danmark" Expedition, from a geological point of view, must be certainly included the establishment of the fact of the occurrence of Carboniferous Formations on the east coast of northern Greenland, between 80° and 81° north latitude, on Holm's and Amdrup's Land — at Hekla Sound and Ingolf's Fjord, the Mallemukfjæld, and other places — and the collection of fossils there.

In this district Captain Koch and Dr. Wegener have made collections of fossiliferous rocks, some of them containing a fossil land flora, others a fossil marine fauna. The plant-fossils have already been dealt with by Professor A. G. Nathorst in his paper which is to be found in "Meddelelser om Grønland", Vol. XLIII, Nr. 12. The marine Carboniferous rocks occur within exactly the same localities as the plant-bearing formations, and directly cover these latter, so that a description of the general geological conditions here coincides almost exactly with that given by Nathorst, and, like that account, is, for the most part, based on the report made by Mr. Hakon Jarner, the geologist of the Expedition.

The map given here (Pl. XXX) is based on the map of Northeast Greenland drawn by Captain Koch in accordance with the measurements made by the Expedition, and all the names given are in accordance with the map in question. The localities of the finds have been entered in accordance with the information given by Jarner and, partly, according to Dr. Wegener's diary and communications of Captain Koch.

The following summary is given from Jarner's communication in Nathorst's paper:

"The Carboniferous formations occur on the coast outside the Archæan rocks, and here form a plateau which, at the farthermost point of the coast, attains a greatest height of 500 metres, but which,

more inland, is somewhat lower, the land-surface sloping gently towards the west. West of the Carboniferous formations, the Archæan rocks usually rise to a height of about 1,000 m.

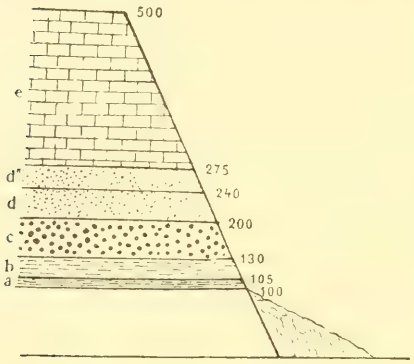


Fig. 1. Section of the Carboniferous rocks at the Depôt 80°09′. (a), fine and soft black shale; (b), gray shale; (c), conglomerate; (d), sandstone without fossils; (d″), fossiliferous sandstone; (e), limestone rich in corals.

There is a gentle dip of the Carboniferous strata towards the east and north, and the oldest deposits are, consequently, found at the western boundary of the formation. On the northern shore of Hekla Sound, about 7 km. east of Depôt 80°09′, there were found loose slabs of a micaceous slate with plant fossils. At Depôt 80°09′ there was drawn the accompanying profile (Fig. 1). From the foot of the mountain up to 100 metres above sea-level, the rock is hidden by loose debris, but, at the height mentioned, black and grey shale become visible as a 30-metre thick bed. It is this shale which has given the greater part of the plant fossils that form the basis of NATHORST's account. The shale is covered by a conglomerate about 70 metres thick, dark red in colour,

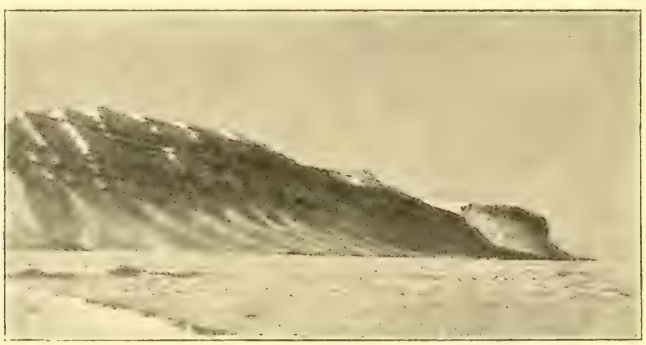


Fig. 2. Coast between "Depôt 80°09′" and "Mallemukfjæld".

and containing well-rounded pebbles of the size of a hazel-nut; their size gradually diminishes upwards, and the conglomerate passes into a red sandstone which forms the rock until a height of 275 metres above sea-level is reached. The lowest part of the sandstone contains no fossils, but from 240 to 275 metres there is an abundance of them, brachiopods especially. From 275 m. to the summit

(about 500 metres), the mountain is composed of a dense limestone, rich in corals.

Judging from the dip of the strata, the uppermost layers at Depôt 80°09′ (Fig. 2) form the base of the Mallemukfjæld. As that mountain, which is about 500 metres in height, also consists of limestone, the total thickness of the Carboniferous formations can be estimated as being at least 700 metres.

No faults have been observed within the Carboniferous formations".

From this communication of Mr. JARNER one must, with NATHORST, draw the conclusion that the plant-bearing beds occupy the basis of the Carboniferous deposits of North-east Greenland, and that the entire formation is probably a downthrow block outside the boundary-fault of the Archæan "Horst". In NATHORST's opinion there can be no doubt as to the age of these plant-bearing formations in their entirety, and he refers them to the Lower Carboniferous, although the material available is too little and too badly preserved to allow of any more detailed conclusions being drawn. NATHORST compares several of the plant-species occurring here with those found in the Lower Carboniferous of Spitzbergen.

Mr. JARNER has, further, favoured me with some extracts from Dr. WEGENER's diary, which have been of great value for the unravelling of the stratigraphical connection between the various localities, and my account is based essentially on these communications, in addition to the investigation of the material collected, both from a petrological and a palæontological point of view.

The collections are not specially extensive — numbering altogether a little more than one hundred specimens — and, consequently, the description of the sections, for instance, is somewhat imperfect, in addition to which, the state of preservation of the fossils is sometimes rather poor. But material collected under such difficult circumstances, and conveyed some 600 km by means of dog-sledges, from a district to which it can hardly be expected that a fresh expedition will soon be sent, makes it the duty of the examiner to make the most far-reaching deductions that are possible from the specimens placed at his disposal. This is the explanation of the circumstance that, in many instances, all the material or every fossil obtained by the Expedition has been made the object of a special mention.

Throughout the work there is employed, given in *italicised* figures, the numbering of the specimens which was made at the Mineralogical Museum in Copenhagen, as, during the course of my work, I made constant use of these numbers, and clearly perceived

that such a system was advisable for a future identification of the specimens treated of in these pages.

In AMDRUP's account of the Danmark Expedition ("Meddelelser om Grønland" vol. XLI), a little is said respecting the geological finds, but the present writer thinks it advisable to recapitulate what was given there. The Carboniferous formations in this district were observed during the course of the great sledge-journey northwards, in April and May, 1907. The two sledge-expeditions, each consisting of three men, which, under the command of MYLIUS-ERICHSEN and Captain KOCH, were to carry out the great exploring journeys to the most northern of the then altogether unknown parts of East Greenland, here separated from the parties that accompanied them so far for the purpose of provisioning, etc. One of these provisioning parties returned on the 23 of April from the Mallemukfjæld, and the other on the 26 of the same month from Sophus Müller's Naze. This latter party consisted of Dr. WEGENER, the meterologist of the Expedition, and G. THOSTRUP, and was not to return direct to Danmarks Harbour, but was to carry out geological investigations in Ingolf's Fjord and Dijmphna and Hekla Sounds.

The places in AMDRUP's account where the geological conditions are mentioned are the following:

P. 117. "*April 20:th.* . . . . KOCH and WEGENER made geological investigations at Mallemukfjæld and collected specimens of the carbon formation there. . . . ."

P. 118—119. "*April 24:th.* . . . . At Eskimo Naze. . . . . Almost all went to work to collect either Eskimo relics, such as darts, snow-knives, fragments of sledges and kaiaks, etc., or fossils, of which many occurred here even in the sandstone used by the Eskimo as building material. The collections were deposited in a depot at the spot, to be fetched on the return journey. . . . ."

P. 119. "*April 26:th.* . . . . Sophus Müller's Naze. . . . . At this settlement also the sandstone was full of fossils, especially bivalves and corals. In the course of half an hour a very considerable collection had been made and deposited at the place to await their return. MYLIUS-ERICHSEN, however, specially requested KOCH not to take the Eskimo objects, if he should arrive first at the tenting place. . . . ."

The following may be quoted from the account of Captain KOCH's return journey:

P. 137. "*June 9:th.* . . . . From Eskimo Naze they took with them a number of fossils deposited there by WEGENER. . . . ."

On the other hand, the account does not report that, on his return journey, Captain KOCH carried with him any geological col-

lections from Sophus Müller's Naze, which, however, he certainly did.

The main part of the geological observations, as well as of the collections of fossils, were made by Wegener and G. Thostrup, and on pp. 143—145 there is some mention made of their labours.

The first day after their saying farewell to the sledge expeditions that continued northwards was:

"*April 27:th.* After making some survey observations at the tent-place, G. Thostrup and Wegener at 10.30 a. m. drove out to the Henrik Kröyer's Islets in order to investigate these skerries, which are only 20 metres high. . . . .

On the islands as well as on the land itself they found numerous fossils. . . . ."

"On *April 29:th* the tent was pitched on the northern side of the (Ingolf's) fjord, and here they were obliged to wait until the *3:rd of May*, before they had clear enough weather to make the necessary surveys and observations.

During this delay, however, Wegener had the opportunity of thoroughly examining the surrounding landscape. . . . ."

During this wait, fossils were collected and profiles were taken in two rivers and west of Cape Jungersen.

The time from May 3 to May 11 was employed to the journey along the coast of Holms Land to Mallemukfjæld.

"On *May 11:th* they drove into the district south of Holm's Land. It proved to be a sound, the two branches of which, Hekla Sound and Dijmphna Sound, encircled Lynn Island and afterwards ran between the mainland and Hovgaard's Island down to the Nioghalvfjerdsfjord.

During the days from the *11:th* to the *18:th of May*, Hekla- and Dijmphna Sounds were examined and surveyed. . . . . A lot of fossils were found there. . . ."

The fossils collected in this district were of marine animals, some of which are described in the present paper, and also the land plant-fossils described by Nathorst in his paper mentioned above.

In Amdrup's account there are no other remarks referring to the Carboniferous formations in this district.

The collections that have been confided to me for the purpose of examination are only in part derived from the solid rock, and consist in a great degree of loose fragments found on the shore, or talus-boulders found on the slopes. In many places, however, not only have specimens of rock or fossils been collected in situ, but more or less complete sections of the series of strata have been obtained, for which reason the localities have been marked on the

map Pl. XXX according to their value: # = sections; + = finds of rocks and fossils in situ, and ○ = finds of loose fossils or loose stones.

Sections have been made in 4 places, the most southern in two spots on the outer part of Hekla Sound, and the most northern in two places in the outer part of Ingolf's Fjord. The two southernmost sections lie direct W. of Mallemukfjæld, at a distance from each other of a couple of hundred metres; the most western, on the labels and in the diaries, has been called KOCH's section, and the most eastern, the Conglomerate section. They lie in the immediate vicinity of Depôt 80°09′, and from them have been obtained the greater part of the plant-fossils described by NATHORST and the profile figure communicated by JARNER to NATHORST, and which is reproduced here too, is referable just to these sections, perhaps KOCH's chiefly (see below).

On the north coast of Ingolf's Fjord, two profiles have been taken, one, the most westerly, in the "Western river", and one at the mouth of the fjord, about 3 miles W. of Cape Jungersen called the Cape Jungersen section. In addition, the specimens collected at the Eastern river are so related that conclusions can be drawn from them respecting the sequence of the strata, and that, with a tolerable amount of accuracy, they can be formed into a profile connected with that from the eastern river.

Fossils from the solid rock have also been collected: at Mallemukfjæld, on the north coast of Ingolf's Fjord, on the Henrik Kröyer's Islets and on the mainland behind these latter (depot 80°43′).

Free-lying fossils and rock specimens have been collected: in Hekla Sound, W. of KOCH's profile; at Mallemukfjæld; at Eskimo Naze; on the north shore of Ingolf's Fjord; on the Henrik Kröyer's Islets; on the mainland behind these, and at Sophus Müller's Naze, i.e., in addition to the find-localities for solid rock, collections of free-lying material have been made at Eskimo Naze and at Sophus Müller's Naze.

As the sections that have been taken — incomplete although, it is true, they are — contain fossils that can be referred to certain geological levels, and also certain characteristic rocks, a comparison between them can give a fairly collective view of the stratigraphy of the district. In the following pages, therefore, a detailed description of the various occurrences of the fossils will be given.

It has not always been possible to make the petrological description of the various kinds of rock sufficiently positive, in consequence of the often rather small supply of material available, so that the comparison between the different rocks from the various

localities is, occasionally, somewhat uncertain. In many cases, however, a microscopical examination has given specially reliable characterizations for the determination of the relationship or diversity of the various rocks, a fact of great importance, as, for carrying out the megascopical examination, the material available was often less than equal to a clenched hand in size. The microscopical investigation has given specially valuable information respecting the occurrence of certain smaller organisms — *Fusulina*, especially — in the series of strata, as well as with regard to the fragments of larger or smaller organisms forming part of the various rocks.

In addition, the microscope has made valuable contributions to the solution of the problem of the process of formation of the rocks occurring in the districts mentioned above.

For the purpose of comparing the rocks in question with material from the Carboniferous Formations of Spitzbergen and Beeren Eiland, I have had the opportunity to avail myself of the rich collections brought home to the State Museum of Stockholm by Swedish expeditions, and I am happy to have this opportunity of giving my heartiest thanks to Professor Gerhard Holm, the head of the Zoopalæontological Department, for the readiness with which he has allowed me access to the collections, both of fossils and of the specimens of rock, under his care. My friend, Professor Carl Wiman, of Uppsala, who has examined the rich brachiopod fauna in the Carboniferous of Spitzbergen and Beeren Eiland, has, during the whole period of my work, assisted me with information, not only regarding the brachiopod fauna, but also as regards the rocks composing the Carboniferous series of strata of these regions. Without his valuable assistance, indeed, my deductions, in several instances, would not have been at all as safe as I am now able to consider them.

My heartiest thanks are due to Mr. Edward Adams-Ray of Stockholm, for the translation to English.

The fossils have been photographed by Mr. A. Hj. Olsson of the Geological Survey of Sweden, Stockholm, and the photographs have been retouched by Mr. J. V. Englund of Stockholm. Both of these gentlemen have carried out their task most successfully.

II. Description of the localities.

A. The localities of Holm's Land.

These places are, firstly, the two profiles in the outer part of Hekla Sound, at Depôt 80°09', Koch's section and the Conglomerate section; secondly, the Mallemukfjæld, and, finally, Eskimo Naze, where, however, only boulders were collected, though these prove to be very nearly related to the rocks from the Mallemukfjæld.

In addition to the localities just mentioned, collections, both from the solid rock and from boulders, were made from a place to the west of Koch's section, about 7 km. west of Depôt 80°09'. Specimens from the solid rock have been obtained from two levels — at 85 and at 155 metres above sea-level — consisting of sandstone and sandy shale.

The rock specimens from 85 metres above the sea (*N:o 188*) are a greyish, coarse-grained shaly sandstone, containing indistinct plant-impressions. This sandstone contains a large amount of mica, both muscovite and biotite, and fragments of only slightly decomposed felspar. The grains of quartz are fairly well rolled, and are held together by a cement containing both silica and some clay-substance. This sandstone seems to contain all the constituent parts of a granite or a gneiss, and has, very probably, been deposited in the immediate neighbourhood of a coast consisting of fairly new cliffs of such rock. According to Dr. Wegener's statement in the list of the collections, this sandstone lies beneath the principal shales containing Lower Carboniferous flora.

The other specimen obtained from the solid rock (*N:o 171*) was got from a height of 155 metres above the sea. The rock in this specimen is very nearly related to the foregoing and, like this, contains indistinct plant impressions. The rock is a somewhat brownish dark gray, thick-bedded, evenly deposited sandstone, containing

a large amount of mica (biotite) and some felspar; the cementing substance is brownish, clayey or chloritic. Compared with the rock described above, from 85 metres above sea-level, the constituent parts of the original granite or gneiss must have undergone a more thorough alteration, the clayey cementing substance, especially, pointing to deposition at a somewhat greater distance from the coast. According to Dr. WEGENER, this rock covers the sandstone shales which contain the plant-fossils. The level of these shales, then should be between 85 and 155 metres above sea-level.

At the same place, W. of KOCH's section, there have been found at a level of 10 metres above the sea, some fragments (*N:os 180, 193, 199, 200, 202*) of a red-gray to chocolate-coloured limestone with some dark slickensides without other megascopically visible fossils than fairly large trunks of *Chaetetes radians* FISCH. Megascopically, the rock looks almost close-grained, but, under the microscope, it proves to be very finely crystalline in structure, containing numerous spherical bodies about 0.2 mm. in diameter, and a few fragments of fossils, including rotaliform Foraminifera, no *Fusulina* being observed. These fragments have, of a certainty, fallen from higher levels.

KOCH's section. From this locality there is a series of limestones, all of which have been obtained at a height of 200 metres or more above sea-level, partly from the solid rock and partly as free-lying stones.

At 200 metres above the sea there have been obtained from the solid rock, partly a gray limestone (*N:o 144*), and also a reddish limestone (*N:o 155*). The gray limestone is almost close-grained, with small veins of calcite, which are more clearly visible under the microscope; of the smaller fragmentary fossils the greater part were particles of crinoids, but there are also rotaliform Foraminifera and some few *Fusulinae*. It is fairly evident that this gray limestone has been stratified alternately with more shaly deposits. Of fossils it contained a gastropod shell, probably *Euomphalus* sp., a pygidium of a trilobite and small crinoid stem-joints. The red limestone (*N:o 155*) is an impure, clayey, greatly re-crystallized red or red-brown rock, which has evidently alternated with shales and clays. This rock agrees very nearly with the rock from Beeren Eiland, called by J. G. ANDERSSON Ambigua limestone. Of the same rock (WEGENER mentions "red sandstone" in his list) there are a couple of loose fragments (*N:os 143* and *194*) containing 2 specimens of *Euomphalus* sp., found somewhat lower than 200 metres above the sea; a rugose coral (*N:o 145*) derives from the solid rock at 200 m.

At the same level, 200 metres above the sea, there has been

obtained another species of limestone — I am uncertain whether it was from the solid rock or from free-lying stones — viz., a light reddish-gray limestone (*N:o 150*), which, to the naked eye, looks like a close-grained rock containing numerous small stem-joints of crinoids; under the microscope, however, it proves to consist of a finely crystalline matrix, in which lie imbedded numerous fragments of fossils, mostly remains of crinoids, followed by brachiopod spines and Foraminifera, *Bigenerina, Tetrataxis* and *Fusulina.*

The next level where rock specimens were obtained from the solid rock is 240 metres above sea-level (*N:o 140, a* and *b*). *N:o 140 a* is an almost black, somewhat shaly limestone, alternating with deposits of a more shaly and clayey nature which, for the most part, consist of small fragments of fossils of various species. In consequence of weathering, this rock has obtained a lighter colour, and, on the surface, is grayish or gray-green, a closer examination showing that the dark, almost black colour, depends on the presence of organic substances, as, on heating, it becomes of a light gray colour. Under the microscope this rock proved to consist of numerous fragments of fossils, most of them crinoid stem-joints, brachiopod spines and shells, zoaries of Bryozoa, and some few rotaliform Foraminifera, inbedded in a matrix which is somewhat re-crystallized and contains a dark bituminous pigment, fairly evenly distributed over the whole. This rock is characterized by *Spirifer supramosquensis* NIKITIN, of which there are several specimens in the same rock from other localities, partly in KOCH's section, at 275 metres above the sea (*N:o 152*), and also in the Conglomerate Section. Other fossils than this species of *Spirifer* cannot be given as distinctive of the rock in question; its petrographical appearance is, however, so peculiar, that, within this relatively restricted tract, a certain stratigraphical importance should be ascribed to it. It is also of some importance for comparison with the Carboniferous deposits of Spitzbergen, as it possesses certain clear points of connection with the Fusulina limestone of Spitzbergen, or, as v. STAFF and WEDEKIND call it, the "Foraminiferal sapropelite". A more detailed account of the relation borne by these two rocks to each other will be given in the comparative survey, Chapter IV, p. 597.

From the same level there has been gathered a limestone showing traces of a more thorough re-crystallization, containing fragments of fossils which are entirely transformed into large individuals of crystalline calcite, and the matrix to a finely crystallized limestone. In one free-lying boulder (*N:o 157*) from the same level there lies a badly preserved *Spirifer*, although this, too, is a *Sp. supramosquensis* NIK., in a light gray, somewhat reddish limestone; on the

shore, in the same locality, in a free-lying boulder of similar rock (*N:o 141*), there has been discovered a *Spirifer Fritschi* Schellw., very badly preserved, it is true.

Close by, higher up on the cliff, at a level of 275 metres above the sea, there have been collected specimens of the solid rock. Here we find the same bituminous limestone as at 240 metres, but at the higher level the rock contains, in addition to crinoid stems, numerous small *Fusulinae*. Among the larger fossils there come from this level the specimen, already mentioned, of *Spirifer supramosquensis* Nik. (*N:o 152*), and also *Spirifer fulmari*, n. sp. (*N:o 166*). In this locality, too, the bituminous, somewhat shaly limestone seems to stand in connection with a more evenly bedded and denser limestone (*N:o 165*). This kind of rock somewhat gives the impression of being silicified, and contains a piece of a brachiopod shell which can very well belong to *Sp. supramosquensis*, and of smaller fragments of fossils, in addition to crinoid stem-joints pipes, brachiopod spines and fragments of Bryozoa, a number of Foraminifera — mostly *Fusulinae*, but also some few specimens of *Bigenerina* and *Tetrataxis*.

Somewhat to the eastward of Koch's section lies the Conglomerate section, from which there also exists a series of specimens.

The Conglomerate section. According to Dr. Wegener's diarynotes, the lower part of the slope, up to 120 metres above the sea consists of detritus and snow which cover shale and shaly sandstone. At the level mentioned we find a dark-red, stratified conglomerate containing pieces of rock as large as a fist, pebbles of Archæan rock. There is only one little specimen of this conglomerate (*N:o 185*) which, besides, is unfortunately greatly weathered, so that it is impossible to draw as safe conclusions from it as is desirable. The conglomerate seems to be composed of a not very specially well-rounded weathered detritus, the grains of which are of greatly varying size; in the specimen at hand they varied from the size of a hazel-nut to that of a mustard-seed. The greater part of the pebbles consist of quartz, but some appear to be granite, or some other crystalline rock of a fairly light colour. The weathered part of our specimen is red, and the grains are so loosely cemented that the rock can easily be crumbled; the interior, sound part is somewhat lighter in colour and presents the conglomerate grains inbedded in a white, opaque matrix, which is crystalline and possesses a lustre like that of mother-of-pearl or silk; it is not very hard and is insoluble in acids. By means of chemical and optical examination it proved to be baryte. The unimportant amount available of this rock does not allow of any account being given of the

nature and formation of the conglomerate; it is not even possible to see from the material how the rock is stratified. A conglomerate with baryte as the matrix is, however, probably of rare occurrence.

Neither the labels in the collection nor Dr. WEGENER's diary-notes make any definite statement respecting the thickness of the conglomerate, but from the diary it is clearly evident that, upwards, it passes into sandstone, and, in the lower part, it alternates with limestone. For, from 130 metres above sea-level there has been obtained material (*N:o 176*), of light limestone, regarding which the diary states as follows: — "130 m. Heller Kalk mit wenigen Fossilien, in 3 m. dicken Bändern wechsellagernd mit dem Conglomerate, das nach oben immer feinkörniger wird and bei 150 m. schon fast einem Sandstein gleich sieht (*N:o 183*). Zerfällt leicht in rote Erde".

The limestone is a very light yellow-gray, finely crystalline and very compact, with a few glide surfaces. No fossils were observable with the pocket lens. The sandstone from 150 metres is very loose, and consists of unevenly large quartz-grains, which, in the unimportant material at hand, are sometimes as large as a pea, and are cemented together by means of a red-brown matrix which seems to contain clay and mica.

At 175 metres there was found a thick bed of limestone, of which 10 metres lay exposed; it was rich in fossils and a drawing in the diary indicates rugose corals. The fragments that have been brought home (*N:os 182* and *184*) show, however, little of determinable fossil remains. *N:o 184* is a gray, dense, somewhat clayey limestone and, of larger fossil fragments, contains the umbonal part of a brachiopod (probably a *Spirifer*) and other fragments of fossils; among others brachiopod spines. Specimen *N:o 182* seems to consist of another species of limestone, as far as can be made from the unimportant material at hand. On the one surface, which is weathered and worn, or polished by the wind (by means of snow or sand) the rock is of a light-gray colour, and here can be seen a number of small fragments of fossils, mostly stems of crinoids, and also a number of small *Fusulinæ*. On the inner surface the material shows a somewhat clayey and darker matrix, which points to the presence of bituminous substances. It reminds one somewhat of other bituminous limestones of this series.

At 190 metres above the sea there begins a gray-green, somewhat calcareous sandstone (*N:o 186*), fairly fine-grained, containing a pretty large number of grains of felspar, together with mica, both dark and white; this sandstone, consequently, is formed of products of degradation, which have been but little altered, probably from a

granite. WEGENER says of it: "Es waren nur sehr undeutliche Spuren von Fossilien in dieser Schicht zu sehen (Kriechspuren)".

At 200 metres above the sea there was exposed a peculiar series of strata, of which WEGENER speaks as follows: "200 m. sehr dunkler schwarzer Kalk (violetter Ton) mit zahlreichen deutlichen Fossilien, auch Muscheln. Mit 4 schiefrigen oder erdigen, mit dem Messer spaltbaren Zwischenlagen (je 1 dcm. dick). Die 3 obersten wimmeln von Muscheln". This bituminous limestone with intermediate marl-shale partings is probably the same stratum as that in this profile at 175 metres above sea-level; and that in KOCH's section at 240 metres above the sea; the fossil-contents confirm the relationship with the bed in question in KOCH's profile. The "Muscheln" mentioned by WEGENER are certainly brachiopods; in the specimens (*N:os 190* and *192*) obtained from this locality, there are 5 specimens of *Spirifer supramosquensis* NIK., 3 specimens of *Spirifer rectangulus* KUT., var. *alta* n. var., 1 specimen of *Productus simensis* TSCHERN., 1 specimen of *Chonetella nasuta* WAAG. and some few rugose corals. Both the harder limestone and the alternating marly beds are highly bituminous, but, on heating, become of a gray-yellowish colour; in consequence of weathering they have, on the surface, obtained a gray-green tinge. The limestone contains a large number of small crinoid stems, and, under the microscope it shows, in an almost close-grained matrix a number of fossil-fragments of calcite, with fragments of crinoids and bryozoa a few brachiopod spines and *Fusulinæ*.

This bituminous limestone, of the thickness of which no statement is made, is underlaid by a sandstone (*N:o 177*), of which, however, only one layer, 1 decimetre in thickness, was observed. The rock was friable and not very compact; it was brown in colour, rich in mica and finely bedded. The rock overlying the bituminous limestone consists immediately of sandstone, of which WEGENER says in his notes: "Probe aus dem Geröll unmittelbar über dem vorigen = grüner Sandstein, offenbar unmittelbar über dem Kalk in 20 m. dicker Lage anstehend (was wenig mehr östlich zu sehen war). Dann kommen wieder helle und violette Kalke mit dunkelroten Bändern von Conglomerate oder Sandstein wechselnd. Anscheinend vorherrschend Kalk bis zum Gipfel".

The specimen of this green sandstone (*N:o 187*), which is a loose piece weathered out from the rock-wall, and collected in the talus greatly resembles the sandstone found at 190 m. above the sea and, like the latter, is somewhat calcareous.

To judge by WEGENER's notes, his ascent of the Mallemukfjæld

at the Conglomerate section did not much exceed the level of the bituminous limestone and the sandstone superimposed on it, i.e., 200—220 metres above the sea.

There are no specimens from a higher level, but only a loose fragment which was obtained at a height of 170 m. above the sea (*N:o 174*), but which probably comes from a higher bed above the bituminous limestone. The rock is a gray, dense, clayey limestone, probably with partings of a marly or shaly nature; it contains rich fragments of fossils and, of megascopical remains, an *Euomphalus* and a number of small *Fusulinæ*.

On the shore below the cliff, there have been collected a number of free-lying boulders of various limestones, partly fossiliferous. Some are stated to have been found W. of KOCH's section and have been mentioned in connection with that locality. Of others nothing more is said respecting the locality where they were found than "Fuglefjældet", and have probably been collected somewhat more to the east than the profiles, and below the Mallemukfjæld itself. A great number of these specimens must be considered as being derived from the upper limestone strata in the Mallemukfjæld. These specimens will be discussed somewhat later on, in connection with the collections that were made of free-lying stones at Eskimo Naze, and in consequence of the great agreement existing between these rock-specimens, one can, with tolerably great certainty, assume the identity of some of them.

We shall, instead, now continue the discussion of this profile, especially as compared with the profile contributed by JARNER to NATHORST's paper on the plant-fossils.

For the sake of lucidity, we must review the series of strata that have been observed at the three localities W. of the Mallemukfjæld.

1) W. of KOCH's section.

There are specimens of sandstone from 85 and 155 metres above the sea, and between these levels, shales have been found containing plant-fossils. Of the occurrence of limestone in the profile we know only that boulders of limestone have been collected on the shore.

2) KOCH's section.

At the following levels characteristic rocks have been observed in the solid rock:

275	metres.	Dark gray limestone, alternating with black, bituminous shales.
240	—	Dark (gray) limestone, alternating with a black, bituminous, shaly limestone.
200	—	Gray limestone and red limestone (resembling the Ambigua limestone of Beeren Eiland.)
100-130	—	Shales.

3) The Conglomerate section.

At the following levels characteristic rocks have been observed in the solid rock:

220	metres.	Sandstone.
200	—	Dark gray limestone, alternating with bituminous shales.
190	—	Sandstone.
185	—	Limestone with traces of bituminous partings.
150	—	Sandstone.
130	—	Light limestone.
120	—	Conglomerate.

4) The profile communicated by JARNER to NATHORST has the following appearance:

500—275	metres	*e*	Limestone rich in corals.
275—240	—	*d''*	Fossiliferous sandstone.
240—200	—	*d*	Sandstone without fossils.
200—130	—	*c*	Conglomerate.
130—105	—	*b*	Gray shale.
105—100	—	*a*	Fine and soft black shale.

If we compare these conflicting statements, it will still be possible, however, to come to some result respecting the actual order of the strata, and also to see the origin of JARNER's profile and what is intended by it. The statements cannot be brought into full agreement, however, but it is evident that, to obtain his profile, JARNER has adopted the sequence of strata given in KOCH's section

but has added to the latter some details from the Conglomerate section. In addition it should be pointed out that a more detailed examination of the rocks shows other results than those given in the notes made by JARNER after the first cursory determination made on the spot and entered in the diaries.

Fig. 3 shows a profile of the Mallemukfjæld, based on that given by JARNER (Fig. 1), but corrected in agreement with what has been communicated above.

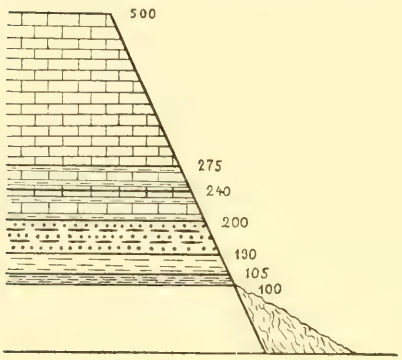


Fig. 3. Section of the carboniferous rocks at Depôt 80°09′. Revised according to the collected specimens.
100—105 m. fine and soft black shale 105—130 m. gray shale, 130—200 m. conglomerate alternating with sandstone and light limestone. 200—275 m. dark gray limestone, alternating with black bituminous shale.

According to the extracts from the diaries that I have obtained, the profile in question has its origin in Captain KOCH's diary: 20.4—26.4 1907, from which the following citations are given unaltered:

"80.09 Mallemukfjældet.
Up to 100 m. fell-debris.
30 m. Shale with plant-fossils.
240—275 m. many fossil-shells.
The cliff itself about 500 m. Sandstone to the top. Ascent not above 275 m.
700 m. Sandstone in the whole".

The above communicated review of the finds at Hekla Sound show that JARNER's profile is, in a high degree, generalized, and in part must be modified. It should first of all be pointed out that the thickness, as given, of the conglomerate cannot be controlled or confirmed by the collections or by the notes that I have available (WEGENER states — see above — that the conglomerate alternates with a light limestone). Secondly, JARNER's series of strata, 200—275 m. of sandstone, must be interpreted as a series of a partly bituminous limestone alternating with layers of shales and sandstones of various character. The series of strata from 200 to 275 m. in KOCH's Section probably corresponds to the series 150—220 m. in the Conglomerate Section, the bituminous rocks, especially, show such a great agreement in regard to their fossils that a correlation can by no means be considered as bold (the distance between these two sections is not so very great, a few hundred metres, but unfortunately it is not known with exactness; in accordance with this combination of the series of strata, the deposits at the Conglo-

merate Section should lie about 50 m. lower than those at KOCH's Section).

However, the profile is, evidently, not so simple as JARNER has drawn it, i.e., a simple transgression with basal conglomerate and an even transition through somewhat finer-grained sandstones to limestones that are certainly marine. In the Conglomerate Section, as summarized above, there have been observed, in addition to the conglomerate, three different beds of sandstone stratified alternately with limestone, and WEGENER's diary notes mention an alternate stratification of conglomerate and a light limestone[1].

The unconformity which is characterized by limestone strata with marine fauna covering the sandstone which contains a land flora, is evidently not the effect of a simple process, but the transgression has taken place very slowly under slight oscillations.

On the shore below the Mallemukfjæld there has been collected a number of boulders containing fossils. Of these stones some have been found W. of KOCH's Section, and are connected with the same rocks of that locality, and have been briefly mentioned above; the others have probably been collected at the Mallemukfjæld itself, where the ice-edge goes pretty high up on the side of the cliff. These rocks present no agreement with the rocks in the two sections already mentioned, but are, in all certainty, derived from strata at a higher level. On the other hand, these free-lying stones that have been collected at the Mallemukfjæld show far greater agreement — both as regards their petrological character and their fossil contents — with the rock specimens that were collected at the Eskimo Naze, these, too, being only free-lying stones. The Eskimo Naze is the outermost north-eastern point of Holm's Land, and lies a good 30 km. north-east of the Mallemukfjæld. Here the shore is low and no solid rock is seen there.

The specimens that were found at these two places can be divided into three different groups, viz.:

a) coarse-grained limestone.
b) fined-grained —
c) silicified —

[1] A quotation from Dr. WEGENER's diary kindly communicated to me by Captain KOCH includes the following remark on this matter: "Ein genaues Profil unter Berücksichtigung aller Bänder erwies sich sehr kompliziert, da alle Lagen an den Übergangsstellen mehrfach wechsellagern".

Of these, a) and b) appear to pass into each other, but the silicified limestone does not seem to have any definite connection with the other more pure limestones, but can very well derive its origin, however, from some limestone of approximately similar character.

The coarse-grained limestone is gray in colour, often dark-mottled, in consequence of the fact that a part of the fragments of fossils, especially brachiopod spines, of which it contains a fairly large number, are almost black. Of smaller-sized fossil-fragments, it contains crinoid stems, fragments of bryozoa and brachiopod spines, the latter being probably the most numerous. The fine-grained limestone is lighter in colour, and has often a yellow-grayish tinge, and contains considerably more of a crystalline matrix than the coarse-grained. Here, of the smaller fossil fragments the brachiopod spines diminish greatly in numbers, the fragments of bryozoa probably playing the more important rôle.

The silicified limestone when freshly broken is dark gray in colour, sometimes almost black, while on weathered surfaces it is usually buff, with darker fossil-fragments, especially bryozoa of the genus *Fenestella*. In the fracture it is almost dense and flint-like, so that it is astonishing that, under the microscope, this rock proves to have originally been a rather coarse-grained limestone which has been altered by later infiltrations of silica. In its general appearance, this rock may very well agree with the coarse-grained limestone found here, but the fossil contents are somewhat different and so are the structural details. Under the microscope this rock proves to consist of numerous fragments of fossils in a very scanty matrix containing only inconsiderable calcite, and consisting mostly of chalcedon in aggregate-polarizing masses. The fossil-fragments which are, partly, of a fairly considerable size, are crinoid stem-joints (in a majority), parts of bryozoa and brachiopod spines; they have not become silicified but the calcite substance they contain is unaltered.

In addition to the brachiopods, these rocks contain but few forms of preserved fossils, although fragments occur very numerously. The two limestone species contain about the same fossils, of which may be noted *Alveolites* sp. and a bryozoan with a very wide and prostrate zoary. In the silicified rock, the genus *Fenestella* is fairly numerous. The fossil contents of these rocks are about the same, both from the Mallemukfjæld and from the Eskimo Naze.

These rocks present a certain resemblance to certain rocks occurring in the carboniferous deposits of Spitzbergen; thus, certain fragments of the coarse-grained limestone resemble the Spirifer limestone of Lovén's Mountain on the Hinlopen Strait, and the silicified

limestone, especially as regards the weathered specimens, the Productus flint of Spitzbergen.

Of these rocks there are the following numbers in the collections:

a) Of the coarse-grained limestone:
from the Mallemukfjæld: *N:os 142* and *167*.
— - Eskimo Naze: *N:os 196, 197, 205 b, 208* and *213* (pars).

b) Of the fine-grained limestone:
from the Mallemukfjæld: *N:os 149, 153* and *154*.
— - Eskimo Naze: *N:os 198, 203* and *204*.

c) Of the silicified limestone:
from the Mallemukfjæld: *N:o 159*.
— - Eskimo Nase: *N:os 205 a, 207, 210, 211, 212* and *213* (pars).

These rocks contain fairly numerous brachiopods, and, in the palæontological description it is stated in which of the specimens named the respective species are found, while in the list given p. 589, there is mentioned only the fossil-contents of the different kinds of rock. Regarding specimen *154* of the fine-grained limestone which has given such a wealth of species that their unquestionable occurrence in one stratum is specially worthy of mention, see p. 591.

B. The localities on the South Coast of Amdrup's Land.

On the northern side of Ingolf's Fjord, on the south coast of Amdrup's Land, fossils and fossiliferous rock have been collected by Dr. Wegener at several places, which, reckoning from west to east, can be summarized under three headings: the Western river; the Eastern river and the Cape Jungersen section. It should be mentioned now that Koch's map shows only one river, which goes down to the shore here on the south coast of Amdrup's Land, and that this river lies W. of Wegener's camping place 29 4 —2 5. If the hut marked on Wegener's sketch stands for this camping place, the river marked on the map would, therefore, be the western one, and then we should be able to calculate the distance between the Eastern and the Western rivers at 8—9 km. This was also ascertained by kind communication of Captain Koch and amended on the map Pl. XXX. These three localities, consequently, lie approximately in the direction of the dip of the strata, and the difference in age between the various levels can here (as was the case for the localities at Hekla Sound) be noted with fairly great probability, even if, in consequence of our wanting exact

information respecting the dip, it is impossible to draw up any reliable, continuous profile.

A sketch by WEGENER, shown in Fig. 4, gives, however, a fairly acceptable grouping of the material obtained at the western river,

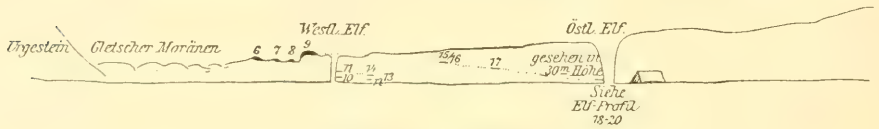


Fig. 4. The localities on the south coast of Amdrup's Land. Sketch by Wegener.

if taken in connection with the notes in his diary. In the following account of the rocks, the numbers employed by WEGENER are given in leaded type near the margin.

The Western River and the Coast on both sides of it, to the Eastern River.

"6. Küstenfelsen, Gipfel (nur hier im Tage tretend), westlichster Punkt mit festem Gestein, 110 m.".

The material (*N:o 147*) consists of a light-gray, somewhat reddish, fairly crystalline limestone, where the fossils consist of some small ostracoda, unimportant fragments of trilobites and a number of crinoid stems. Under the microscope one can see some fragmentary fossils of various kind inbedded in a matrix of crystalline calcite.

"7. Gipfelgestein, wenig mehr südöstlich, 100 m.; anscheinend ohne Foss."

"8. Gipfelgestein, *N:o* 7, ähnlich, mehr fest mit Foss. Steht etwas mehr südöstlich an".

Of these rocks, there are two specimens (*N:os 137* and *156*), both of which are a grayish, somewhat calcareous sandstone resembling the sandstones occurring in the sections at Hekla Sound, and evidently formed like these direct from the degradation-products of archæan rocks. The specimen from the most western locality shows a somewhat thinner bedded and shaly sandstone than that from the most eastern — 8 — which is a thick-bedded and compact sandstone. The specimen shows no fossils, but the character of the rock makes it probable that it contains plant remains.

"9. Gipfelgestein. Dunkel-violetter Kalk mit Foss. 110 m. Etwas weiter südöstlich auf dem vorigen aufsitzend. NB. dasselbe wie 15—17?"

This limestone (*N:o 163*) is a dark, somewhat bituminous lime-

stone, which, of megascopic fossils contains only crinoid stem-joints and a short species of *Fusulina* or, perhaps, *Fusulinella*, rather. Under the microscope it proves to consist of very closely packed fragments of fossils, with but little matrix, that which exists of the latter, however, being calcite. This rock bears a great resemblance to the dark limestone (*N:o 146*) mentioned below, which, however, lies considerably lower in the series of strata.

All the specimens previously treated of are derived from the low hill-tops west of the western river, and next follows a series of specimens collected at the river and direct eastwards from it. From the profile and the notes in the diary it can be concluded that these last named specimens are derived from beds lying lower in the series of strata than the mountain-tops in the west.

"10. Nahe östlich von dem vorigen, an der Mündung eines Elfs (Cannon) 10 m. also wohl das tiefste anstehende Gestein. Mit Foss. (wenig), fast schwarz".

This rock (*N:o 138*) is a dense dark-gray, somewhat bituminous limestone, the larger fossil contents of which include fragments of brachiopods and of some smaller *Primitia*-like ostracoda and, probably, *Fusulinella*.

"11 a, b. Darüber lagernd mehr grünliche, durch Verwitterung auch rotgefärbte Kalk- oder Sandsteine (wechsellagernd mehrere Male mit dem dunkeln Gestein, von dem wenigstens 2 dunkle Bänder in dem Sandstein gesehen wurden: das dunkle Gestein bisweilen schieferig). Reihenfolge wahrscheinlich unten 10, darüber 11 a, darüber 11 b, dann wieder 11 a, 11 b, 11 a und ähnliche, mehr und mehr gelblich rote Sandsteine (wie 6, 7, 8), bis zum Gipfel".

The specimens belonging to this group (*N:o 164*) are, firstly (11 a), a gray-green sandy clay-shale or, possibly, a sandstone shale, slightly calcareous, and irregularly bedded; secondly, (11 b), a very impure gray-green limestone in which no fossils could be observed megascopically, with the exception of some unimportant fragments of coal-substance. The rock contains iron in a very high degree, and is very similar to clay ironstone.

On microscopic examination, it proved to be greatly different to the other limestones occurring in these sections. The matrix consists chiefly of particles of calcite, mostly of a crystalline nature, but sometimes containing impurities, being then only slightly crystalline in structure. There also occurs yellowish siderite in fairly large quantities, usually rusty and weathered. Small angular grains of quartz lie fairly evenly distributed throughout the whole mass. Organic parts are exceedingly scarce, the only ones distinguishable being irregular shell-fragments of crystalline calcite, probably

derived from molluscan shells (gastropoda and lamellibranchiata); all the fragments of bryozoa, brachiopod spines and foraminifera, which were so common in the other limestones, are, on the other hand, entirely absent. As was stated above, this rock alternates with an irregularly stratified clayey sandstone, its nature recalling in a high degree deposits of impure clay ironstone (spherosiderite) in terrestrial strata. The coal fragments it contains also support such an interpretation, as does the absence of smaller organic fragments, which are so prominent in the other limestones in the series, even if, megascopically, these appear perfectly dense.

Somewhat further eastwards, east of the mouth of the river, some rock specimens were also obtained:

"12 (bildet mit 13 und 14 ein Profil) etwas östlich von der Elfmündung, ca. 10 m. über d. Meere. Dunkler Kalk, etwas grünlich getönt, mit kleinen weissen Fossilien. Untere Grenze verdeckt, ca. 2 m. Dicke freilegend. Oben übergehend in

13. Dem vorigen ähnlich, mehr schieferig. Anscheinend ohne Foss. Nur etwa 1/2 m. dick.

14. Rötlicher Sandstein (?) mit zahlreichen in Nestern zusammensitzenden Fossilien, von ca. 5 m. über dem Meere ab aufwärts, ca. 30 m. freiliegend".

This series consists of three specimens; 12 of a limestone (*N:o 146*) almost black and somewhat bituminous; it is unevenly bedded and appears to possess partings of more shaly or marly character. 13 is a gray clay shale (*N:o 162*), fairly well stratified and slightly calcareous. 14 is a yellow-red limestone (*N:o 136*) with alternating deposits of clay, recalling the Ambigua limestone of Beeren Eiland, and agreeing perfectly with the red limestone which, in KOCH's profile, was found, partly in situ at 200 m. (*N:o 155*) and partly as boulders at a somewhat lower level (*N:os 143, 144* and *194*).

The dark limestone (*N:o 146*) contains of megascopically visible fossils nothing but crinoid stem-joints and a few ostracoda. Under the microscope it proves to contain numerous fragments of organisms in addition to crinoid-parts, foraminifera, which are specially numerous, both a *Fusulina* (fairly numerously represented) and, more rarely, *Tetrataxis* and *Bigenerina* and rotaliform species. There are, in addition some few young forms of gastropods and fragments of brachiopod shells. These fossil-fragments which are, partly, preserved in crystalline calcite or enclose this substance, seem to lie inbedded in an almost dense matrix.

The red limestone (*N:o 136*) has, megascopically, a uniform, very finely crystalline appearance, which is broken only by some few crinoid stem-joints. Under the microscope this rock proves to consist

of small fragments of organisms, the origin of which can but seldom be determined, but which, as a rule, are rounded and are probably rolled, and cemented together by crystalline calcite. In the limestone there were observable some fragments of brachiopod shells and a couple of *Fusulinae*. In the limestone mass there occurs in the joints of strata a red-brown clayey mass, pointing to shaly partings.

As far as can be judged from the diary-notes and the sketch of the find-localities, the sequence of the deposits reckoning from below upwards should be as follows: 10, 11, 12, 13, 14, 6, 7, 8, 9, i.e., a series of strata consisting of alternate deposits of limestone (predominantly dark-gray and almost black, but also reddish and red-brown) and shales, in the superior part of which series there exists an intermediate stratum of sandstone.

The other material found were free-lying stones and are probably derived from about the same level as 9, or probably somewhat higher up in the series. WEGENER speaks as follows of these pieces:

"15. Muschel (?) in dunklem Kalk auf dem Meereise aufgesammelt. Offenbar anstehend (durch dunkle Färbung markiert) in etwa 80 m. Höhe (von unten geschätzt). Etwas länger östlich vom letzten Profil.

16. Dasselbe, grösseres Stück mit kleineren Foss. Diese beide Stücke gehören also sicher über das letzte Profil.

"17. Offenbar dasselbe, wie 16. 20 minuten von unserem Zelt als vorspringende Klippe in ca. 60 m. Höhe aufstehend (die best erhaltene Steilklippe westlich unseres Lagers). Am Abhang im Geröll aufgesammelt".

Although these pieces were found free-lying, and their stratigraphical position, consequently, is somewhat uncertain, still they are of fairly great importance on account of the fossils they contain.

15, is a fragment of dark-gray clayey limestone (*N:o 161*), or, perhaps, and, equally well, a marly shale with interbeddings of a somewhat more calcareous nature. On the surface the colour is somewhat lighter, in consequence of weathering, and the dark colour, as well as other circumstances point to some percentage of bitumen. The rock contains a number of small fragments, such as of brachiopod spines, etc., and a part of a *Spirifer* — the umbonal portion of a ventral valve. This is specially badly preserved, but both its general form, the great thickness and massive build of the shell, and what can be seen of the cardinal teeth and the dental plates make it extremely probable that this shell belongs to *Spirifer supramosquensis* NIK., even if nothing of the sculpture of the shell is visible. The petrographical character of the rock, as far as can be judged by the unimportant fragment at my disposal, speaks, too, for a relationship with the limestone and shale beds in KOCH's section

and, still more, with those in the Conglomerate section containing *Spirifer supramosquensis*. In addition to this *Spirifer* the material contains a fragment of a very small brachiopod shell preserved in light-blue calcedon, which forms a connection with specimen 16, which, however, is somewhat more red-gray and lighter in colour, and is a denser limestone. This fragment (*N:o 158*) contains, in addition to the above-mentioned brachiopod-shell in blue chalcedon, probably belonging to a species of *Chonetes*, a couple of indeterminable shell-fragments of another brachiopod and crinoid stems. The third piece, 17, which WEGENER wishes to place in the same category with the two already mentioned, presents some points of dissimilarity from these. The rock (*N:o 160*) is a light red-gray limestone, containing both larger and smaller fossils. Of brachiopods it contains a somewhat large dorsal valve of *Productus punctatus* MARTIN, and a couple of compressed and badly preserved specimens — both the ventral and dorsal valves — of a species of *Productus* belonging to the *semireticulatus* group, and a little ventral valve of another *Productus*. In the rock there lie scattered fine, short spines of *Prod. punctatus*, and also coarser, as much as 2 cm. long spines of the species belonging to the *semireticulatus* group. Of smaller fossils the material contains numerous crinoid stem-joints, and also some scattered specimens of *Fusulinella*.

Even if the darker (*158*) and the lighter limestone (*160*) present, exteriorly, a certain dissimilarity, still, the texture of the rock in both is fairly analogous and, under the microscope, the two specimens have a great resemblance to each other and to the red limestone (*N:o 136*). The dark limestone contains a fairly large amount of a dark clayey substance filling the interstices between the particles of calcite, and has only rarely foraminifera, partly rotaliform and partly of the genus *Tetrataxis*. The light-red limestone shows numerous sections of *Fusulinidæ*.

The Eastern River.

Farther to the east, at the river in the immediate neighbourhood of the camping-place, WEGENER has measured a profile through the strata, or, more correctly speaking, he has made two, connected with each other, the one at the mouth of the river, embracing WEGENER's specimens 18—23, and one farther up the river: specimens 24—31.

The lowest levels in these profiles present a certain likeness to the rocks from the hill-tops farther to the west, and, according to WEGENER's sketch, they should lie pretty close above these latter.

The lowest stratum in the profile at the river-mouth (*N:os 106* and *118*) consists of a limestone or a calcareous shale with numerous fossils, which occur chiefly in the alternating calcareous deposits; of these may be noticed corals: a *Syringopora* and a large trunk of a tabulate coral; of bryozoa especially a *Fenestella*, and several examples of a *Bellerophon* and of a little gastropod. The rock is dark-gray, with a tinge of violet; the shaly layers with fossils in the more calcareous alternating deposits are probably the most prevalent, but there occurs, in addition — to judge from the free-lying material (*N:o 118*), an impure, very compact limestone, which is highly recrystallized, and does not contain any other megascopic fossils than some few branches of *Bryozoa* and, possibly, a little species of *Cladochonus*. Of this rock only 2 metres are exposed, and its position is 2 metres above sea-level.

Above this limestone follows a series of limestones, termed by WEGENER "Knollenkalk" and with regard to which he states:

"Ca. 50 m. dick, von demselben Character. Probe aus den untersten Lagen, hier hell und sauber, weiter oben dunkler". There are specimens of different limestones from several places in this series of strata, as a rule dense in appearance, but which, on closer examination, prove to contain fossils in smaller or greater numbers. The specimens from the various levels are given in the sequence in which they occur.

From the lowest part of this limestone series there are specimens of a light, gray-yellow, dense limestone (*N:os 117, 127* and *105*), which, under the microscope, proves to contain a fairly large amount of organic fragments: crinoid stem-joints, brachiopod spines and foraminifera, inbedded in a pretty dense matrix. Here and there the rock presents slickensides covered with a dark coating. In this limestone there are silicified portions which have a more or less flint-like and concretional appearance, to which WEGENER's term "Knollenkalk", evidently refers. On a microscopic examination of the limestone it proved to contain parts where a silicification had begun. A thin section from *N:o 105*, especially — which specimen also contained a flint-like concretion — presented a silicification of fragments of crinoid-stems, which showed a transformation to chalcedon, of a yellowish colour. A thin section from *N:o 127* proved to contain a few *Fusulinæ*.

Somewhat higher up in the profile, 15 metres above the level of the sea, begins a dense gray limestone without any larger fossils (*N:o 114*), from which, on the weathered surface project a few fragments of crinoid stems, preserved in a red-yellow chalcedon substance. The weathered surface presents fairly richly sec-

tions of *Fusulinæ*. Under the microscope the rock agrees fully with *N:o 105*.

The next higher level from which there is material available is 35 m. above the sea-level. Here begins a red-gray, highly recrystallized dolomite (*N:o 124*), in which fossils are no longer preserved. The entire mass is crystalline, with some few holes, probably after fossils. Here and there exist larger crystal-masses which, probably, chiefly represent fragments of crinoids. On treatment with LEMBERG's re-agent, the whole mass proved to consist of dolomite.

Fig. 5. Slide of the siliceous rock from "the Eastern River". Amdrup's Land. Specimen *N:o 107*. Enlarged 12 diam.

From the same level (35 m. above sea-level) there is a specimen (*N:o 107*) of another rock, which has also been highly altered, but in another direction. No mention is made, however, of the relative positions of the two rocks.

The rock now in question is an almost white or faintly yellowish-gray, mottled siliceous rock, which does not at all effervesce on treatment with hydrochloric acid, so that the original calcareous constituents have been entirely removed. The rock is porous, however, so that it cannot be called a flint, but probably represents an intermediate stage in the formation of flint or of a siliceous rock. Of larger fossils it contains only some few imprints of larger crinoid stem-joints, which, like other cavities after fossils, can be clothed with secondary quartz-crystals. As above mentioned, the rock-mass is almost white, but it is filled with more or less perfect specimens of foraminifera, chiefly *Fusulina*, although *Bigenerina* and rotaliform species are also present. The shells of these foraminifera are preserved in a yellowish-red chalcedon-mass which, to some degree, gives the rock a mottled appearance. Under

the microscope the silicification is distinctly visible, and both the chalcedon — usually of a somewhat yellowish-red colour in the transformed shell parts — and the new-formed colourless quartz, can be observed very clearly. Fig. 5 shows a thin section of this rock.

There have been obtained some pieces of *Chaetetes radians* Fisch. (*N:o 100*) from a height of 60 metres above the sea-level, entirely altered into dolomite, but otherwise extraordinarily well preserved. In colour they are of a yellowish-white, and the fragments of rock to which they were attached are a dense, light gray-red rock, which does not re-act on the addition of hydrochloric acid and, consequently, is probably entirely altered into dolomite.

At two higher levels there occur highly recrystallized limestones, dolomitic in a high degree, but still retaining some of the original calcareous matter. Neither contain fossils. At a height of 75—80 metres there occurred, in a bed 5 metres thick, a very hard, almost black or dark gray rock, which effervesced but feebly on the addition of hydrochloric acid (*N:o 104*) and thus forming a fairly pure crystalline dolomite. Somewhat higher, at 85 m. above the sea, there was a closely allied rock (*N:o 116*); it was yellowish-gray in colour and fairly loose in texture, finely crystalline and, on a superficial examination, resembled a sandstone. On the addition of hydrochloric acid, effervescence ensued, and so it possibly still contains some carbonate of lime. In the rock there were some gliding-surfaces with a black coating which at once attracts the attention.

At a level of 90 metres above the sea there occur other rocks viz., partly, a shaly bituminous, almost black limestone (*N:o 119*), containing rather numerous fossil fragments, especially crinoid stem-joints and brachiopod spines, which are specially prominent on weathered rock surfaces, that acquire a greenish-gray tinge and, secondly, a somewhat crystalline dark gray limestone (*N:o 125*) which, with some amount of certainty, may be stated to alternate with the more shaly rocks. This bituminous shale agrees very well in habitus with similar rocks on the north side of Hekla Sound, both in Koch's section and in the Conglomerate section. The specimen brought home from this locality in Ingolf's Fjord has not given any fossil allowing of a closer comparison between these rocks in Ingolf's Fjord, while, of the fossils found in the more compact rock (*N:o 125*), it has only been possible to determine *Productus longispinus* Sow.

Wegener's diary gives the following information respecting the rocks lying at a higher level and above this bituminous limestone:

"Schiefer ohne Foss. 105 m.

"Sehr bröckliger Sandstein, den grünen Lehm liefernd, ohne

Foss. 120 m. Verwitterungsprodukte hiervon bis 5 m. unter dem Gipfel (130 m.)".

The shale (*N:o 126*) is a black shale with straight cleavage, containing a fairly great amount of combustible matter, and some percentage of carbonate of lime. Of organic remains there was only one object, 2 mm. in size, which is possibly a fish-vertebra, and there is nothing to tell us with certitude if this is a marine or a terrestrial deposit.

The sandstone (*N:o 101*) is light-gray in colour, does not effervesce on the addition of hydrochloric acid, very much resembles other light sandstones within the district and, like these, seems to be formed of the products of degradation of a granite. As mentioned before, this sandstone is the highest stratum reached in these sections.

Here, in Ingolf's Fjord, consequently, there have been measured profiles which, as will be seen by what has already been stated, represent a series of strata of at least 200 metres. This series very much resembles that which was observed in the sections at Hekla Sound, and the transgression of the marine Carboniferous deposits has, here too, progressed in several stages, and oscillations in the sea-level have led to the alternate deposition of the fossiliferous limestone series and the sandstone deposits. The analogy between the profiles becomes all the more striking if we take into consideration that, here, in Ingolf's Fjord too, there is, farther to the east, a profile which, in a predominant degree consists of the limestones in the Cape Jungersen section, of which a more detailed account will be given below.

The Cape Jungersen Section.

This section has been measured in a mountain on the south coast of Amdrup's Land, at the mouth of Ingolf's Fjord, east of the two river profiles that have just been described. If close attention be paid to the map Pl. XXX, there will be found given there as the promontory forming the southernmost extremity of Amdrup's Land, Cape Jungersen, and, directly westwards of this name, two mountain tops, the most westerly, 510 metres, and the easternmost 400 metres in height. It is impossible to decide with certainty from which of these tops the collection designated as the Cape Jungersen section has been obtained. From WEGENER's sketch-map I am most inclined to take the western height, but, on the other hand, he mentions in his notes that the rocks of which the top consists, have been taken from a height of between 300 and 400 metres.

Captain KOCH has kindly communicated to me that Cape Jungersen is the whole mountain and that the fossils were collected by

Dr. WEGENER on the land that lies nearest to the camping place of 4 5, and the probable place for the Cape Jungersen section is marked on the map Pl. XXX according to this statement.

Up to a height of 65 metres above the sea, the foot of the hill is covered with talus; at the height mentioned there begins a white limestone (*N:o 112*) in which, at a height of 70 metres above sea-level, there is interstratified a 5 metres thick bed of a light-gray limestone (*N:o 135*) with a somewhat reddish or yellowish tinge. This limestone is very dense and somewhat splintery, and, of fossils, contains some brachiopods, among which *Dielasma* sp, whose shells in this dense rock are entirely decomposed, so that they cannot be specifically determined.

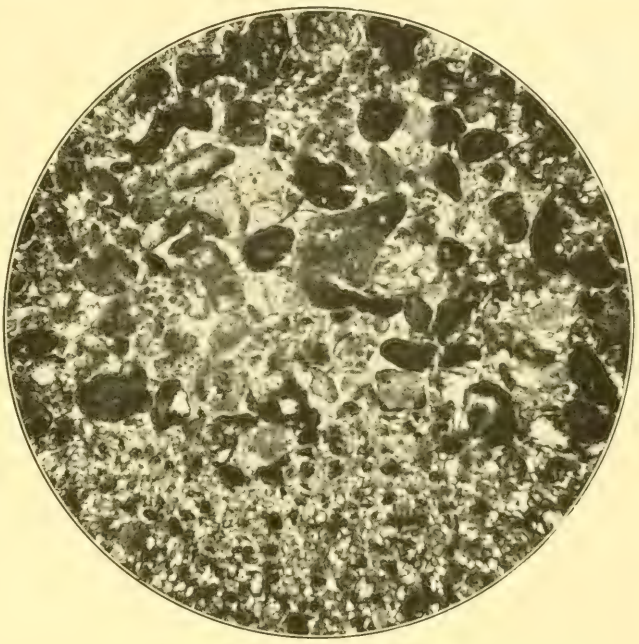


Fig. 6. Slide of the gray limestone, specimen *N:o 102*, from the Cape Jungersen section. Enlarged 12 diam.

The white limestone (*N:o 112*), presents some petrographical peculiarities which it possesses in common with a limestone (*N:o 102*) which has been obtained at a somewhat higher level, between 100 and 110 metres above the sea. A detailed description of the structure of these two rock-species will, therefore, be given below.

N:o 102 is a stratified limestone without megascopic fossils; it is of a light gray colour with black particles. On a closer examination of a surface of stratification it is found that this rock is, so to say, "a conglomerate in miniature", for the surface in question presents numerous, somewhat irregular rounded or oblong grains about 1 to 2 mm. in length, which often possess such a smooth surface that, in the case of grains of a more regular form, one is led to imagine the possibility of an organic origin, ostracodan shells, for example. The microscopic examination spreads full light on the

nature and formation of this rock. Fig. 6, shows a microphotograph of this rock, the section taken a right angles to the stratification. It shows clearly that the rock consists of rolled fragments of various parts of fossils, inbedded in a matrix consisting chiefly of crystalline calcite. These "pebbles", however, do not consist entirely of rolled fossils and fragments of fossils, but also of parts of a rock containing fossils; i.e., the products of the degradation of a rock that was already solidified. Among the fossils that can be determined with certainty, *Fusulinæ* and other foraminifera are specially numerous, besides which there also occur fragments of bryozoa and crinoids. Of inorganic matter there are numerous small grains of quartz, about 0.1 mm. in size. In some laminæ the quartz is more prominent, so as to form almost a sandstone, as shown in the upper part of fig. 6.

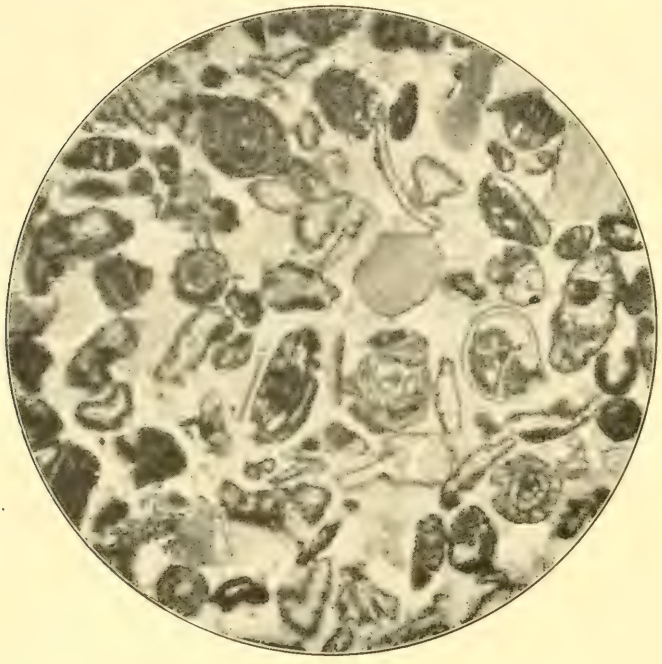


Fig. 7. Slide of the white crystalline limestone, specimen *N:o 112*, from the Cape Jungersen section. Enlarged 15 diam.

The white limestone (*N:o 112*) has, megascopically, very little resemblance to the rock just described, it being an entirely white rock of almost crystalline appearance, with small cavities spread within the mass; the fracture of the rock is uneven but, even with the aid of a pocket-lens magnifying to ten diam., it is impossible to distinguish with certainty the constituent parts of the rock. Under the microscope, on the other hand, the real nature of the rock becomes very clear, and the microphotograph, Fig. 7, gives a good representation of its appearance. It is seen at once that the original formation of this rock is almost analogous with that of the rock described above, but that it has undergone a more complete diagenesis than the latter. The "pebbles" found here are somewhat larger, and sometimes even exceed 3 mm. in length;

among them the fragments of crinoid-stems and foraminifera, *Fusulina* especially, are the most numerous. There is a total absence of quartz-grains, and the matrix is here more prominent than in *N:o 102*. This rock too, has undergone a more complete diagenesis than *N:o 102*, being entirely transformed into crystalline calcite. In addition to this re-crystallization, a subordinate silicification has taken place, which has affected parts of the matrix and the "pebbles", and which has there been observed in the crinoid-stems.

It is evident that these rocks have been formed in very shallow water, and perhaps actually at the shore, as such a rolling and attrition as are seen here can hardly have taken place in deeper waters. In addition to the fact that they give us further examples of the oscillations of level that occurred during the formation of this series of carboniferous strata, they also afford support to the opinion that has been brought forward from other quarters[1] respecting the conditions of existence of the *Fusulinidæ*, i.e., that these organisms belonged to the benthonic fauna of shallow seas. The greatest possibility is, of course, that these rolled fragments are derived from the organic life that existed in the shallow water off the shore, even if we cannot entirely deny the possibility of a rock — a *Fusulina* limestone — which was already deposited and solidified, having undergone entire degradation along the edge of the shore.

At a somewhat higher level, between 100 and 110 metres above the sea, there outcrop limestone deposits; a gray-green, fairly dense limestone (*N:o 131*) in which only crinoid stem-joints could be observed; a light yellow-gray, very finely crystalline limestone (*N:o 122*) from 115 metres above sea-level, and a red-gray tinged limestone (*N:os 103* and *134*), greatly resembling the foregoing from 120 metres above the sea. In this rock there were numerous crinoid stem-joints and some few sections of a rugose coral and a *Fusulina*.

At 150 metres above the level of the sea there were found talus boulders of limestone (*N:os 109, 113* and *133*), which Dr. Wegener assumes to be derived from the limestone lying at the same level. The fossils are two specimens of an *Euomphalus* and some fragments of rugose corals and bryozoa. The rock is a reddish-gray, dense and somewhat variable limestone of coarser grain than any of the limestones forming part of the Cape Jungersen section. To some degree, but not perfectly, it bears a resemblance to the finer grained limestone (p. 528) occurring in the Mallemukfjæld, and among the loose blocks on the Eskimo Naze.

Afterwards there have been no specimens collected from the

[1] Staff u. Wedekind, 1910. Pp. 85—86.

solid rock before a height is reached of 210 metres above the sea, from which we have one of a white, crystalline limestone (*N:o 110*), a rock which agrees perfectly with that previously described (*N:o 112*), and evidently of the same origin as the latter.

In his diary-notes Dr. WEGENER states: "Bei 210 m. beginnt eine grosse Schutthalde, welche roten und grünen Sandstein verhüllt, und fast ganz aus Bruchstücken des Gipfelkalkes besteht (nach der grünlichen Farbe)", — There are two specimens of this red "sandstone", both procured as talus boulders, one (*N:o 130*) at 210 metres above the sea, the other (*N:o 132*) at 100 metres. On closer examination, this rock proves, however, to be, not a sandstone but a limestone. It is extremely finely crystalline, and, on weathering, the rock gives the impression of being a fine-grained sandstone. Diluted hydrochloric acid dissolves the rock completely, leaving an unimportant residuum of reddish quartz-grains. Both pieces are red, with white spots, and have a mottled surface. From specimen *132*, the surface of which is somewhat weathered, it is seen that these white calcareous parts are definitely outlined remains of some organic origin (the case is probably the same with *N:o 130*, but I have not been able to decide the matter with certainty, as I did not consider it right to sacrifice any of the little fragment at my disposal to make a thin section). These tube-shaped calcareous formations are about 1 mm. thick, have a winding, irregular course and sometimes have ramifications. In some of the specimens one can see on the surface that they are hollow, so that their form can be called cylindrical.

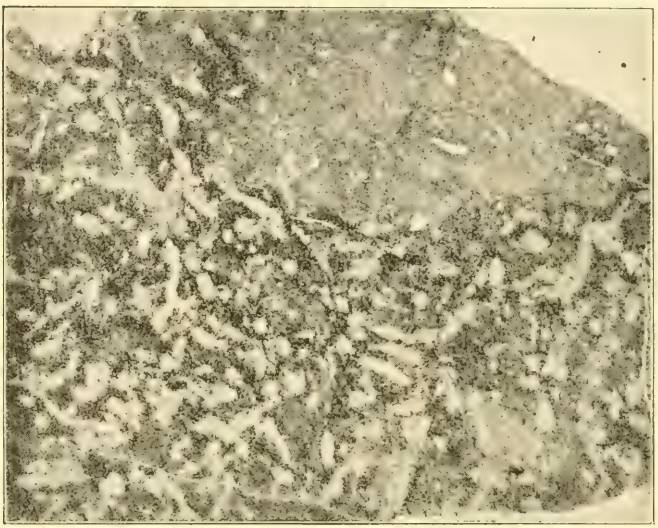


Fig. 8. Slide of the red limestone, containing quartz-grains from the Cape Jungersen section, specimen *N:o 132*. Enlarged 3 diam. This thin section shows the irregular shape and extension of the tubes, considered to be "algæ".

A thin section of these formations (Fig. 8—9) shows, on micro-

scopical examination, that the limestone contains small angular grains of quartz, and also that the organic formations above-mentioned, are preserved in calcite, and that it is easy to determine their shape. Their forms lead us to think more immediately of a connection with algæ. My thin sections show that they possess a perceptible cavity in the middle, and also a fairly thick exterior wall which appears to be undulate interiorly, and thereby apparently able to enclose small, divided compartments in the said wall.

A closer, expert examination of this peculiar fossil will, probably, be carried out before any very great time has elapsed.

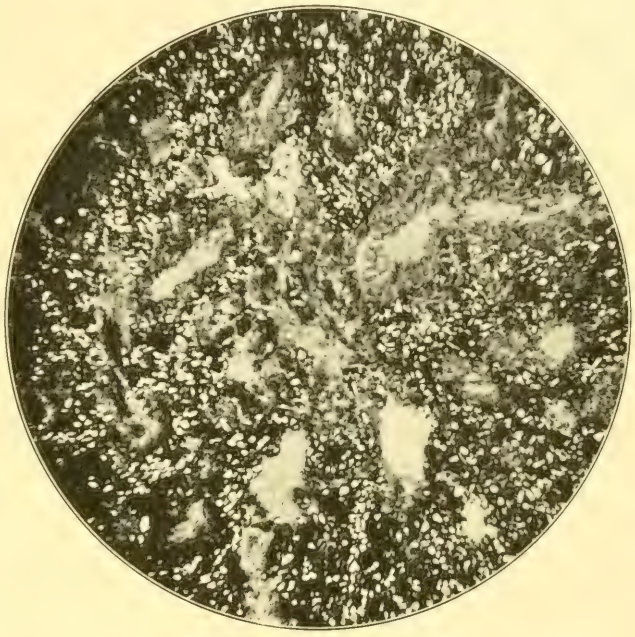


Fig. 9. Slide of the red limestone, containing quartz-grains from the Cape Jungersen section, specimen *N:o 132*. Enlarged 8 diam. This thin section shows some tubes of the "algæ" presenting the interior cavity and the undulate structure of the wall.

In addition to the purely phyto-palæontological importance of this discovery, it is also of stratigraphical weight, as it points to a shallow water, and to an algal vegetation growing there.

The whole of the profile that has been observed with certainty in the Cape Jungersen section, consists, therefore, of limestone, and there exists no evidence showing the presence of any interbedding of sandstone in the series. The limestones that have thus been found in situ present no decided resemblances to the rocks in the Mallemukfjæld and at Eskimo Naze, but, in general, are somewhat finer in grain than these, and only some few fragments (*N:os 109, 113* and *133*), which, in addition, are not known, of a certainty, to have been found in situ, have any connection with the finer-grained rocks from the Mallemukfjæld.

On the slope of the hill there have been found several limestone

boulders (*N:os 111, 120, 128* and *129*) containing fossil remains, the rocks in these cases presenting a nearer agreement with those from the Mallemukfjæld and the Eskimo Naze, especially as regards the finer-grained specimens, even if there also exists some connection with the coarser-grained too.

At a height of 60 metres above the sea there was found in gray, fairly fine-grained limestone (*N:o 129*), a large trunk of a *Syringopora*, and unimportant remains of other corals.

At 165 metres above the sea were found the other three (*N:os 111, 120* and *128*), all containing brachiopods, and Dr. WEGENER considers them to derive their origin from the limestone at the summit of the mountain. *N:o 111* is the rock in closest agreement with those from Mallemukfjæld—Eskimo Naze, and can hardly be distinguished from them. It is a grayish-yellow, fairly finely crystalline limestone, containing some few grains of a dark mineral, and some fossil remains, especially silicified brachiopod shells. There is also a fairly well preserved ventral valve of a *Spirifer* (n. sp., ex. aff. *Sp. duplicicostae* PHILL.).

Each of the other two fragments (*N:os 120* and *128*) contains a silicified speeimen of the ventral valve of a large *Productus; N:o 120* of *Pr. boliviensis* d'ORB., and *N:o 128* of *Pr. inflatus* M'CHESN. Both rocks are somewhat more coarsely crystalline than *N:o 111*, and do not seem to contain any dark constituent parts.

As the strata here in Ingolf's fjord, like those at Hekla Sound, dip to the east, we have here, in the Cape Jungersen section and the River sections, too, parts of a continuous profile, where the purer limestones at the top are superimposed on the alternating sandstone and limestone strata in the lower parts of the profile.

C. Sophus Müller's Naze and Henrik Kröyer's Islets.

In addition to the collections that were made on the south coast of Amdrup's Land in Ingolf's fjord, there are also some smaller ones from the eastern part of Amdrup's Land, on the south side of Antarctic Bay, viz., a) WEGENER's collections from Henrik Kröyer's Islets and the mainland behind them (27. 4. 1907), which places, in WEGENER's diaries, and on the labels, are given as "Observationsø ved nordligste Teltplads" (Observation island; the most northern camping-place) and "nordligste Teltplads paa Fastlandet" (the northernmost camping place on the mainland), and b) the collections that were made (26.4) at Sophus Müller's Naze (on the labels marked "Eskimoboplads 80°55′), and probably carried home to the vessel by

Captain Koch on his return from the great sledging expedition. At the former places the collections were made both from the solid rock and of free-lying fragments; at the last-named place, of free-lying boulders alone.

Henrik Kröyer's Islets and the Mainland behind them.

The rocks visible here are all dolomites of fairly crystalline character.

On the mainland there outcrops at a height of 30 metres above the sea, a light gray yellow, strongly crystalline dolomite (*N:o 201*), in which no fossils could be observed. Similar rocks occur on the islets, one of them a pure, light-gray dolomite (*N:o 172*), without fossils, found at 10 metres above the sea, and another a dark gray, fairly porous and loose dolomite (*N:o 173*), at 3 metres above sea-level. In this rock there were found traces of fossils, probably belonging to a coral of a genus closely related to *Amplexus;* other remains could not be at all clearly identified. In all these dolomites, there exist small groups of dolomite crystals.

On Henrik Kröyer's islets there were collected a number of free-lying fossils (*N:o 191*), altogether 16 specimens of different kinds. Among those must be noticed a silicified specimen of *Productus timanicus* Stuck., as the only brachiopod, preserved in a white dolomitic limestone which is in very close agreement with the white limestone from the Cape Jungersen section. In addition, there are a number of fragments of a rugose coral, some with rock attached; it is a light gray limestone with a faint reddish tinge; is almost dense or very finely crystalline in structure, and contains some scattered specimens of *Schwagerina princeps* Möll.; it much resembles the fine-grained limestones found free-lying at about 150 metres above the sea in the Cape Jungersen section (*N:os 100, 113* and *133*). The other fragments are, in general, more or less silicified, and are portions of the rugose coral already mentioned, or also of trunks of a *Syringopora.*

From the mainland behind Henrik Kröyer's islets there are also a number of free-lying fossils and fragments of rock containing fossils (*N:os 206* and *214*).

N:o 206 are silicified fragments of a light rock containing the same coral as that found on Henrik Kröyer's Islets, and some poor examples of a *Spirifer.*

N:o 214 embraces limestone fragments of various kinds containing fossils of several different species.

N:o 214 a is a trunk of a *Syringopora,* probably *S. geniculata* Phill., preserved in a finely crystalline light gray yellow limestone.

N:o 214 b is an almost dense, gray yellow limestone, containing *Schwagerina princeps*, and, possibly, *Fusulina;* it recalls the Henrik Kröyer's islets rock containing *Schwagerina*, and contains of other fossils nothing but an impression of a *Productus*.

214 c is a gray, somewhat mottled limestone containing a specimen of *Productus pseudohorridus* WIMAN, and a specimen of a little *Productus* and one of an *Alveolites*.

214 d is a gray, somewhat mottled limestone, recalling the more finely crystalline limestone of the Mallemukfjæld, but with the transition to the more coarsely grained; a thin section showed perfect agreement with this rock. Of fossils, the fragment contains a specimen of *Productus pseudohorridus* WIMAN, and a poor specimen of a *Spirifer*, or rather, perhaps, *Spiriferella*, and impressions of several *Spirifers* as well as an impression of an *Alveolites*.

214 e is a gray limestone, fairly like the fine-grained rock from the Mallemukfjæld, containing partly a silicified *Spiriferella* and also the ventral shell of a *Chonetes* and a *Productus*, somewhat poorly preserved.

214 f, g, i, h are silicified specimens of *Spirifers*, more or less complete; the best is *Spiriferella* sp. (Pl. XXVII, figs. 8, 9); the fragment had some rock of light gray limestone attached and, on working out these silificied skeletons of brachiopod shells by means of acid, there were obtained among them particles of moulds constituting the filling of foraminifera, for the most part *Bigenerina*, but of other forms too, although not *Fusulinæ* or rotaliform foraminifera. A part of these moulds represent nearly the whole of the body cavity, others again, only some few chambers.

Sophus Müller's Naze.

The finds made here are derived entirely from free-lying stones, and consist of loose fossils, corals, bryozoa and brachiopods, as well as fragments with larger or smaller portions of rock attached.

The rocks represented here vary very much; the commonest is a white limestone, somewhat dolomitic in character, agreeing with rock *N:o 112* from the Cape profile. Of the rock now in question there are three specimens (*N:os 170, 178 b* and *179*), which, megascopically, are in full agreement with the Cape Jungersen section rock. A thin section of *N:o 178 b* shows that the microscopic resemblance, too, is very striking, and that rolled fragments occur in a fairly crystalline matrix, which fragments, however, are not present in such a preponderant degree as in *N:o 112*, the matrix also containing a number of smaller, irregular fragments of various organ-

isms, partly not rolled. The rolled fragments are, too, more various in size, than is the case in *N:o 112*, while the rock in *178 b* is re-crystallized in a less degree than in *112*. Among the fossils observed in the slide, the foraminifera are most numerously represented, with some few specimens of *Fusulinæ* and *Bigenerina*, with numerous rotaliform species; there are also seen some few crinoid stem-joints and fragments of bryozoa. Of larger fossils, *N:o 178 b* contains a badly preserved *Euomphalus*; *N:o 179 Spirifer* cfr. *striatus* MARTIN, and a *Productus* of the *semireticulatus* group, and *N:o 170* a similar *Productus*.

A similar rock is found in *N:o 209* which, megascopically, and in part, entirely agrees with those just described above, but has undergone more thorough re-crystallization, and has smaller cavities containing crystals of calcite. It also presents layers of a finer crystalline rock which, even under the pocket-lens, appears to be quite dense in structure. On a microscopic examination it proves to agree perfectly with *N:o 112*, the matrix consisting entirely of crystalline calcite, in which lie imbedded numerous rolled fragments, although the size of these latter differs from that in *N:o 112*. While, in some parts of the rock in question this size can amount to as much as that in *N:o 112*, viz., 1—2 mm., it is in other parts considerably less, or from 0.05—0.20 mm., these small grains, too, being, in general, altered to crystalline calcite, while the larger retain their original organic structure as fragments of *Fusulinæ*, crinoid stem-joints, or other organisms. The process of re-crystallization the rock has undergone does not seem to have been accompanied by any dolomitising or silicification.

Of larger fossils the boulder contains two well preserved specimens of *Spiriferina Mylii* n. sp. and a couple of specimens of *Schwagerina princeps* MÖLL., together with several specimens of a long *Fusulina*.

A rock, which, at first sight, appears to be fairly different from those mentioned above but which is probably connected with them, is *N:o 169*, a light gray-red mottled rock which, in its darker portions, contains small lighter coloured "pebbles" resembling those observed in *N:o 112* and the rocks agreeing with the one last-named. Under the microscope the rock in question presents a structure perfectly analogous to that of *N:o 112*, but it seems to contain, in addition to well-rounded fragments, large angular pieces of another, almost dense limestone, embedded in the crystalline matrix of calcite. In this rock there occur, as in *N:o 209*, finer calcareous particles, about 0.1 mm. in size, strewn among the coarser particles. The red colour in the rock is, probably, mainly due to the fact

that the crystalline calcite in the "pebbles" has a fairly evenly distributed reddish pigment.

Of megascopic fossils this rock contains a couple of specimens of a rugose simple coral, and several specimens of *Schwagerina princeps.*

A fragment that is in perfect agreement with *N:o 191*, obtained on Henrik Kröyer's islets, is *N:o 178 a*, which is an almost dense or very finely crystalline limestone, containing *Schwagerina princeps* and also the same coral as *N:o 191.*

There is also a trunk of a coral, probably *Petalaxis* or *Phillipsastraea* (*N:o 195*) in a sandy limestone. Both the coral and the rock present a great resemblance to the corals that J. G. ANDERSSON collected at Beeren Eiland on the slope of Fogelberget towards Ymersdal, in sandstone with beds of coral-limestone, belonging to the lower part of the Upper Carboniferous.

Finally, from this locality may be mentioned two entirely silicified corals (*N:os 175* and *181*), a species of *Syringoporidæ* and a rugose simple coral.

* * *

Of the collections made at the easternmost localities on Amdrup's Land, special attention is drawn by the rocks containing *Schwagerina princeps* MÖLL., as, of course, the occurrence of this species of *Fusulinidæ* definitely determines them as belonging to the upper part of the Upper Carboniferous series. *Schwagerina princeps* has been found both on Henrik Kröyer's islets and on the mainland behind, and at Sophus Müller's Naze.

D. Summary of the Carboniferous deposits of North-east Greenland.

Having, in the preceding pages, given a detailed description of the various kinds of rock belonging to the Carboniferous of North-east Greenland, and also of the stratigraphical conditions under which they may be supposed to occur, we shall now attempt to collect these deposits into larger groups and to compare the different formations that have been observed at the various localities and in the several sections.

This work, too, will be restricted by the character of the material, as a consequence of the unfavourable conditions under which it was obtained.

On the whole, the Carboniferous measures of north-east Greenland can be divided into three groups, a Lower, terrestrial, and two Upper, marine, in the following series:

C. Upper Marine Group:	Limestones without intermediate marl-shale strata; light in colour; partly silicified or altered into dolomite.
B. Lower Marine Group:	Limestones with marl-shale intermediate strata; partly light, fine-grained or almost dense; partly dark and bituminous and then, as a rule, coarser; sometimes alternating with sandstones.
A. Terrestrial Group:	Sandstones and sandy shales with plant-fossils.

A. The Terrestrial Group consists of a continuous series of sandstones and sandy shales, containing a flora (poor, it is true) of Lower Carboniferous age which, as stated before, has been described by Nathorst. These deposits have evidently been formed on a continent consisting of greatly weathered Archæan, or of some similar crystalline rocks, in small fresh water basins which, after the transgression of the Carboniferous sea, have become portions of the latter.

Formations belonging to this group have been met with, with certainty, only at localities in Holm's Land; in Amdrup's Land they have probably been covered by detritus and were, therefore, not accessible.

Some of the places where these beds were observed lie pretty far to the west on the shore, where only free-lying boulders were found, while others were rather near to the profiles made here: Koch's section and the Conglomerate section.

West of Koch's section we have absolute certainty that the plant-bearing shales occupy a position between 85 and 155 metres above sea-level, but, on the other hand, we do not know what lies above them. On the shore, it is true, there have been discovered free-lying boulders of light-red limestones, derived from some unknown higher level.

In Koch's section there have been obtained plant-fossils at different levels which we cannot more definitely determine, but of the localities which Nathorst (1911, pp. 344—345) gives for his plant-fossils, 1 and 3 are levels in Koch's section, while 4—6 refer

to a place about 100 metres eastwards of that section about 90—115 metres above the sea (found both as free-lying boulders and in situ). N:o 10 and 11, again, are from the westernmost spot in Hekla Sound where plant-fossils were discovered.

It is impossible to ascertain with perfect certainty the thickness of this group, but in KOCH's section no limestones have been found lower than 200 metres above the sea, and, in the Conglomerate section they do not make their appearance before a height of 130 metres over sea-level, alternating with the conglomerate. We venture to assume that the conglomerate which alternates with the limestone is the basal conglomerate of the Lower marine group, and occupies the same level as that of the sub-stratum of the lowest limestones in KOCH's section. We should presume, then, that 200 metres is the probable minimum thickness of these terrestrial beds, even if there exists a great possibility that, in consequence of the further extension of the deposit westwards, the actual thickness is two or three times as great.

B. The Lower Marine Group has been formed during the transgression of the Carboniferous sea over the terrestrial formations. As we have already pointed out, this transgression has occurred gradually, and accompanied by slight oscillations which become very evident by the alternating of formations with different development of facies: limestones with marl-shales and sandstones. That the limestones, too, point to the vicinity of land and shallow water is clearly shown by their character, as they are seldom entirely pure limestones but, as a rule, clayey; the terrigenous material, the original mud, which was carried out to sea, is, too, found collected in beds of marl-shale which alternate with the limestone. The large amount of bituminous substances contained both in the marl-shale and in the dark limestone, need by no means point to a great depth of sea for the formation of these rocks, as the remaining characteristics of the rocks give such decided indications of a fairly shallow sea.

The profiles from Holm's Land and Amdrup's Land present certain differences which, it is true, for the most part are, probably, the result of some fortuitous circumstances in making the collections but which, nevertheless, make it necessary to undertake somewhat detailed comparisons between the rock-specimens collected at the two places in question. The differences existing between KOCH's section and the Conglomerate section are not very important, and are in part the result of the dip of the strata, so that the comparison of these sections does not present very great difficulties. The mutual connection, too, between the sections from Amdrup's Land, the two

river sections and the Cape Jungersen section, is fairly clear and evident (see too, fig. 4).

A comparison between the rocks from Koch's section and the Conglomerate section makes it very probable that the bituminous limestones with the alternating strata of marl-shale, which, in Koch's section are seen between 240 and 275 metres above the sea, are identical with the limestones found in the Conglomerate section at 175—200 metres above sea-level. The *Spirifer supramosquensis* Nik. occurring so abundantly in the Conglomerate section is, it is true, not found in Koch's section in such well-preserved specimens that their identity is undisputable, but the peculiar character of the rock, and the agreement in position between the light limestones lying beneath the bituminous beds, and which are found about 40 metres under the lowest strata of the latter deposits, make the identification very reliable (see the comparison between the profiles, pp. 524—525).

In this series of strata we have at least 5 superpositions of limestone over sandstone, signifying phases of oscillation in the great transgression, while the alternation of the bituminous limestone with the marl-shale ought, probably, only to be considered as smaller changes, resulting from periodical preponderances of the organic or the terrigenous material during the process of deposition, when the conditions, in other respects, were almost uniform. As we have already stated, no plant-fossils were found in the sections from Amdrup's Land, so that it is impossible to state, with absolute security, the presence of the terrestrial group there. According to Dr. Wegener's profile-sketch, Fig. 4, the oldest strata here should consist of those found lowest down on the westernmost river, above which should come the rocks found on the hill-summits to the west of the river. The lowest stratum in the river is a dark gray, somewhat bituminous limestone which presents a certain likeness to the bituminous limestone in the sections from Holm's Land. The limestone in question is covered with a gray-green sandy clay-shale alternating with an impure limestone or spherosiderite, which, as well from its exterior appearance as from the microscopical examination, seems to be a terrestrial formation. These beds probably represent a transition from marine to terrestrial conditions, and show an oscillation between them. The succeeding strata in the river consist, reckoning from below, of dark, bituminous limestone (*N:o 146*), gray clay-shale (*N:o 162*), and a yellow-red limestone (*N:o 136*) resembling the Ambigua limestone of Beeren Eiland, and agreeing perfectly with the limestone (*N:o 155*) from 200 metres above the sea in Koch's section.

The next following strata in the hill-summits to the west of the

river present, probably, the following series of strata; a light, gray-green limestone (*N:o 147*), lowest, then, on two hill-tops, sandstone (*N:os 137* and *156*), and, uppermost, dark, bituminous limestone (*N:o 163*). The thickness of this series cannot be judged of, but, in the western river, about 40 metres of rock have been accessible, and, possibly, we may be justified in estimating the whole of the series in the eastern river at about 100 metres. At a geological level which, approximately, lies next above this series, a fragment has been found which probably belongs to *Spirifer supramosquensis* NIK., and is preserved in a rock very much resembling that rock in the profiles from Holm's Land for which this fossil is characteristical, while, in connection with this find there occurred red and red-gray limestone.

A bituminous dark limestone with intermediate marl-shale deposits of the same type and, probably, occurring at the same level, forms the lowest bed of the in the Eastern river section and above this comes approximately 50 metres of light limestones, among which there occur silicified strata and also dolomite. At about 90 metres above the level of the sea there occurs a bituminous limestone of a type similar to the other bituminous limestones in this group. Above this there is found a black, bituminous shale, with straight cleavage, which is not to be connected with the above-mentioned deposits, while, uppermost in the series, we have sandstone to a height of about 130 metres above the sea.

We have here in all, consequently, a series of somewhat more than 200 metres of rock, which, on the whole, present points of agreement with the beds occurring in the sections from Holm's Land, but which, in their arrangement offer certain irregularities that render direct comparisons impossible. When we consider the incompleteness of the profiles, they give, however, some basis for an hypothesis. In the profiles from Amdrup's Land we have, it will be remembered, dark-gray, bituminous limestone at various levels, and this rock occurs both at the lowest and the highest horizons, with a difference of level between them of about 180 metres. In the collections from Holm's Land, the light limestones are represented at a higher level than are the dark, bituminous, and this difference from Amdrup's Land probably depends on the fact that, at the various localities, different outcropping strata have been more easily accessible to investigation.

In any case, the petrographical agreement and, in part, the palæontological too, give indisputable grounds for bringing together for the sake of comparison the formations occurring in these sections, although it is difficult to express an opinion respecting the thick-

ness of the beds in question. In this respect we must be satisfied with giving that of the exposed part of the series of strata, viz., about 100 metres on Holm's Land and about 200 metres on Amdrup's Land.

C. The Upper Marine Group consists of limestones which, as far as we know, have no intermediate beds of sandstones or shales, nor have the limestones any marly character although, however, they can be in part altered into dolomite or to siliceous rocks. Some of the limestones contain quartz sand, but clay is very rare. The petrographical character of the limestones which, as regards some of them, has been given in detail in the description of the localities, points, in many cases, to shallow water and, perhaps, even to shore deposits. The entire character of the formations does not point to deep water, nor, in many cases, to a great distance from the shore, but, what it does point to is, above all, a specially unimportant supply of terrigenous material, while that of the organic must have been greatly preponderant.

The incompleteness of the material for investigation at our command, resulting from the conditions under which it was obtained, makes itself felt in this instance in a far higher degree than in regard to the two groups already treated of, as a not unimportant part of the material belonging to the present division was collected in the form of free-lying boulders some of which were found on the shore.

Specimens obtained from a profile occur only in the case of the Cape Jungersen section, and specimens obtained from the solid rock only from Henrik Kröyer's Islets and the mainland behind them, while moreover boulders have been collected at the Mallemukfjæld, the Eskimo Naze and at Sophus Müller's Naze.

It has been possible, however, to recognize certain types of rock, both in the specimens obtained from the solid rock and also from boulders; it has been of special value for judging of the stratigraphical importance of the whole of these carboniferous formations (*N:o 154*) that, in one large limestone boulder from the Mallemukfjæld, there were found numerous brachiopods of various species.

The Cape Jungersen section clearly marks the lowest portion of this upper marine group, which is shown, partly by the close connection between the River profiles and the Cape Jungersen section, and also by the rocks occurring in those localities; of these rocks, those found between 100 and 110 metres above sea-level are fairly fine-grained, and remind one of similar rocks in the river profiles. The same may be said, although in a lesser degree, of some free-lying boulders of limestone from 150 metres above the sea.

Characteristic rocks from the Cape Jungersen section are the white limestone, consisting of rolled calcareous fragments (pp. 538—540), and the red sandy limestone, in which algae have been found.

Of the free-lying fragments, the greater part has been obtained, partly at the Mallemukfjæld, and partly from Esquimo Naze. It has been found possible to divide the rocks obtained at these places into three groups: a) coarse-graind limestone; b) fine-grained likestone; c) silicified limestone, of which groups, however, a) and b) pass into each other: for the description, see pp. 527—528. All these limestones have been deposited in fairly shallow water, and under approximately similar conditions; the silicified limestone has possessed about the same characteristics as the others in their original development. At present it forms an almost completely siliceous, dense rock, and can easily be distinguished from the fragments of the other limestones whose fossils have become silicified, possibly during a later period. The silicification in this case has occurred with the fossil valves, in the well-known rings of silica.

The connection between the succession of the strata in the Cape Jungersen section and the free-lying boulders from the Mallemukfjæld and the Eskimo Naze becomes very evident from the finds of the characteristic rocks; for example, there has also been found at the foot of the Mallemukfjæld a boulder (*N:o 168*) of the white, crystalline limestone which consists of rolled calcareous fragments, while, on the cliffside in the Cape Jungersen section there were collected talus boulders, both of the coarse-grained and the fine-grained limestone that had been obtained from the Mallemukfjæld and the Eskimo Naze.

North-east of the Cape Jungersen section, collections have been made on Amdrup's Land, partly from the solid rock on Henrik Kröyer's Islets and the mainland behind them, and partly of boulders at both these places and also at Sophus Müller's Naze.

All the above-mentioned rocks in situ are crystalline dolomites, evidently greatly altered limestones.

The boulders from these localities present a number of peculiarities, and they cannot all be referred to the rocks that have been obtained from the localities already treated of.

White, and somewhat crystalline limestone, consisting of rolled calcareous fragments, and which has, later on, been greatly re-crystallized, occurs fairly abundantly, as at Henrik Kröyer's Islets there has been obtained a boulder of this rock, containing *Productus timanicus* STUCK., while at Sophus Müller's Naze, 3 boulders were collected containing 2 specimens of a *Productus* belonging to the *semireticulatus* group, and also a specimen of *Spirifer* cfr. *striatus* MARTIN.

Of the rock-types found at the Mallemukfjæld and the Eskimo Naze, the fine-grained limestone is richly represented from all three localities, and sometimes it contains greatly silicified fossils which can be developed from the unaltered limestone matrix. Some boulders of the other types have also been found.

In addition to the rocks already mentioned, the free-lying finds from the north-eastern part of Amdrup's Land contain some rocks which were not obtained at the other localities, but all are characterized by the occurrence of *Schwagerina princeps*, this fact giving a reliable determination of their level.

These rocks are, first, a light-gray limestone with a tinge of red, containing a large, rugose coral; the rock is very fine-grained or finely crystalline, and recalls the rock-species (*N:os 109, 113, 133*) obtained free-lying at 150 metres above sea-level from the Cape Jungersen section; several specimens of this rock were found on Henrik Kröyer's Islets, and one at Sophus Müllers Naze. On the mainland behind Henrik Kröyer's Islets there was obtained an almost dense gray-yellow limestone containing numerous specimens of *Schwagerina princeps* Möll., and approaching very closely to the rock above mentioned.

At Sophus Müller's Naze there were found two boulders of limestone (*N:os 209, 169*), containing *Schwagerina*, and which, in structure, are in very close agreement with the limestone consisting of rolled calcareous fragments, although each of the boulders presents evident deviations from the general type (see p. 547).

Like the other rock-types found at the Mallemukfjæld and the Eskimo Naze, the rocks containing *Schwagerina* have not been obtained from the solid rock, but, still, from the fossil contents, the conclusion can be drawn — as will be shown later on in more detail — that the rocks from the Mallemukfjæld and Eskimo Naze are of about the same age as the *Schwagerina* horizon in the Carboniferous of Russia. A closer grouping of the rocks that have been discovered as free-lying, cannot be carried out and as the white limestone with rolled calcareous fragments, so characteristic of the Cape Jungersen section, was also obtained as free-lying material at many of the localities where such collections were made, it would seem as if we are justified in grouping the whole of the Cape Jungersen section with the finds of free-lying limestones, even if, thereby, the upper marine group probably obtains immensely greater dimensions than the Lower. With the material at our disposal, however, it would be impossible to carry out a classification based on natural grounds.

The classification of our material, therefore, will be approximately as follows:

	Localities:	Rock-species:
C. Upper Marine Group.	The Cape Jungersen section (oldest); Henrik Kröyer's Islets and the mainland behind; freelying boulders at the Mallemukfjæld, the Eskimo Naze, Henrik Kröyer's Islets and the mainland behind, and at Sophus Müller's Naze.	In situ: fine-grained light limestones and white detrital limestone with "pebbles" of fragments of organic origin, and dolomites. Collected as boulders: Partly the rocks also obtained in situ, partly limestones consisting to a great extent of organic fragments, viz., a) fine-grained, light; b) coarse-grained, dark; c) silicified rocks resembling flint; and, in addition, fine-grained light limestones and also limestones connected with the detrital one in the Cape Jungersen section, all of which contain *Schwagerina*. The thickness impossible to determine, but may be estimated at from 500 to 1000 metres.
B. Lower Marine Group.	At Holm's Land, Koch's section and the Conglomerate section, and at Amdrup's Land, the River sections.	Limestone with beds of marl-shale interstratified with sandstones and shales. At different levels within the group there occur, light, fine-grained or almost dense limestones, dark, more coarse-grained, bituminous limestones. The marl-shales are, as a rule, bituminous. The thickness can be put at 200—300 metres.
A. Terrestrial Group.	Lower part of the profiles or Holm's Land.	Sandstones and shales with plant-fossils. Exposed not more than 200 metres, but their thickness probably amounts to about 500 metres, or possibly more.

III. Palæontological Description of the Brachiopod Fauna.

Dielasma sp.

A little, oblong smooth form, without sinus, 4 mm. high and 3 mm. broad; from the Cape Jungersen section (*N:o 135*). As, however, only one specimen has been found, it is useless to endeavour to identify it with any of the numerous species described.

N:o 1. Rhynchopora Nikitini Tschern.

For synonyms, see WIMAN, 1914, p. 26, TSCHERNYSCHEW, 1902, p. 73.

Of this characteristic species there are 3 specimens in our material, which were injured in developing from the rock; 1 is from the Mallemukfjæld (*N:o 154*), and 2 from the Eskimo Naze (*N:o 204*), all in boulders. The specimen from the Mallemukfjæld is larger, with a width of about 13 mm., and with 5 ribs in the mesial fold, than the best preserved specimen from the Eskimo Naze which measures about 10 mm. in width and has 4 ribs in the sinus and 3 in the mesial fold; this latter specimen is evidently not full-grown.

The species occurs abundantly both in Spitzbergen and on Beeren Eiland, and, in Russia, goes from the Omphalotrochus horizon quite up into the Permian deposits.

N:o 2. Camarophoria cfr. Karpinskii Tschern.

Pl. XXVII, Figs. 1—2.

A somewhat damaged specimen, found in boulder *N:o 154* from the Mallemukfjæld, appears to us to be most in agreement with *C. Karpinskii* TSCHERNYSCHEW (1902, p. 496, Pl. 60, Figs. 2—3) and also presents some points of similarity with *C. globosa* TSCHERN., which is related to the preceding.

The difference from the first-named species is, however, so marked that we cannot at once identify our specimen with it. Had

there been a richer and more complete material at our command it would, perhaps, have been possible to classify this North-east Greenland form as a variety of the species in question.

The greatest difference is that our form has a greater length, with more acute-angled outline of the shell, a narrower beak and less thickness. In order to accentuate this difference we shall, below, compare the dimensions of our specimen and of TSCHERNYSCHEW's Pl. 60, Fig. 2, although it should be remarked that our specimen is somewhat younger, which may, to some extent, be the cause of these divergences.

C. Karpinskii TSCHERN. Pl. 60, Fig. 2: length 19, width 22, thickness 17 mm.
C. cfr. *Karpinskii* — 15, — 15, — 12 — .

In our specimen the surface of the shell is desquamated in the umbonal region, so that the sculpture is not quite distinct, but the ribs are otherwise the same, with the exception that they are somewhat narrower, which, possibly, may depend on the lesser width of the shell, or also from the fact that an indication of a fifth pair of ribs can be distinguished on the lateral portions of both valves. The sinus of the ventral valve can first be observed at about the middle of the valve, but the median ribs of the dorsal valve appear as such already above the middle of the valve.

C. Karpinskii TSCHERN. occurs in the Urals in the Schwagerina horizon.

N:o 3. Athyris Royssii L'Eveillé.

For synonyms see WAAGEN, 1882—84, p. 475.

It is with hesitation that I venture to refer two specimens from the light, fine-grained limestone, *N:o 154,* from the Mallemukfjæld, to the above-mentioned species, respecting whose difference from *A. pectinifera* SOW. there exists some doubt.

TSCHERNYSCHEW, 1884, p. 290, has expressed himself in such a manner that one can understand that he is most inclined to identify these two forms as one species, but in 1902, p. 102, he gives them as separate species, and notes several distinctive features between them, in addition to that of size in general, viz., the absence of a sinus in *A. pectinifera;* the straighter hinge-line, the more powerfully developed beak, with a larger foramen, and the finer and closer-lying spines on the striae of growth in *A. Royssii.*

WAAGEN, on the whole, follows DAVIDSON's views respecting the difference between these two species, and considers that the smaller form where not even an indication of a sinus in the ventral valve is seen, should be classified as *A. pectinifera.*

The two specimens at our disposal must, as regards dimensions, almost be considered as small ones, their width, length and thickness being, respectively, 18, 17.5, 12 mm., and 15.5, 15, 10 mm. Both present some indication of a sinus, the larger specimen to a greater degree than the smaller. Both in their proportions and in form they agree very nearly with smaller specimens figured by Waagen, e. g., on his Pl. 40, Fig. 10 a—d, only that the latter are somewhat broader. Waagen mentions specimens 46 mm. broad, while Davidson, for *A. Royssii*, gives a width of 70—80 mm., and for *A. pectinifera*, about 30 mm.

If a distinction of species is to be maintained, our specimens must be referred to *A. Royssii* L'Eveillé, but the slight material at our service gives no guidance in solving the chief question. From another quarter, however, it should be possible to obtain an argument to show that a complete ontogenetic series of these species would probably present transitional forms and variations so closely connected with each other that these two species, *A. Royssii* and *A. pectinifera*, must be classified as but one. We allude here to the development series of the closely related species, *A. Royssiana* Keyserling, that Wiman, 1914, p. 30, Pl. 1 and 2, has figured from the Spirifer limestone of Spitzbergen. Regarding this series, which consists of more than 40 specimens, Wiman states as follows: "Irgend eine Correlation der Merkmale lässt sich nicht beobachten und die Variation ist richtungslos. Überhaupt zeigt diese Serie wie unvorsichtig es ist, Artbeschreibungen auf zu kleines Material zu gründen. Aus der abgebildeten Serie könnte man leicht Exemplare aussuchen, die man als zu verschiedenen Arten gehörig betrachten könnte, wenn man nicht die ganze Serie hätte, und doch ist in diesem Fall die Erhaltung tadellos".

According to Davidson, *A. Royssii* is a species occurring abundantly in the Mountain Limestone of England and Belgium, while *A. pectinifera* occurs spread through the Permian of England, Germany and Russia. According to Waagen, *A. Royssii* is also found in the Permian deposits of Russia, and, according to Tschernyschew, *A. pectinifera* occurs already in the Cora horizon, and continues into the Permian. In the East Indies, according to Waagen, *A. Royssii* is found in the upper and middle parts of the Productus limestone in the Salt Range, and the same writer has described several nearly related forms as independent species. Diener, in several works, has described both *A. Royssii* and nearly related species, both from the Productus limestone, and from higher, Permian deposits. No stratigraphical importance, therefore, can be ascribed to this form.

N:o 4. **Spiriferina Mylii n. sp.**

Pl. XXVII, Figs. 3—7.

Large shell, strongly arched, with its greatest width at the hinge-line; its outline (determined along the hinge-line and the front line of the shell) triangularly ovate. The cardinal area high and somewhat concave, of the same breadth as the hinge-line, bent backwards so that it forms an angle of about 115° with the plane of articulation for both valves, limited laterally by distinct, sharp margins. The delthyrium occupies about one-quarter of the hinge-line, and extends almost to the beak.

The dorsal valve strongly arched, the greatest arching somewhat below the beak which is small and faintly incurved and extends somewhat beyond the hinge-line. The dorsal valve shows a strongly vaulted median rib which, from the beak, rapidly expands, so that, at the anterior margin, it occupies almost one-third of the same. On each side of this rib there are 5—6 ribs, gradually decreasing in size; the valve shows in the front a fairly evenly rounded outline. The ventral valve is strongly arched at the beak, but is flatter anteriorly. The beak is small, but is strongly arched towards and above the area. The sinus is broad and posteriorly fairly deep but, anteriorly it becomes shallower, at the same time that it increases in breadth, so that, at the anterior margin, it occupies nearly one-third of the entire outline of the valve; here it is possible to observe indications of two flat ribs, one on each side of the sinus. The valve has 6—7 ribs on each side of the sinus, which decrease uniformly in size. The front line of the ventral valve projects at the sinus as an indication of a tongue, corresponding to the median rib of the dorsal valve.

The sculpture of the shell is well marked, with sharp, imbricated laminæ of growth. In addition, the surface of the shell is punctuated with fine pores, arranged in quincunx; the pores are almost about as large as the intermediate spaces, and number about 5—6 per mm.

Dimensions: Length of the hinge-line (width of shell) 25 mm. Thickness of shell, 19 mm. Height of area (measured across the umbo) 7 mm. Length of the ventral valve, 25 mm. Length of the dorsal valve, 19 mm.

Of this species we have, first, one complete specimen, freely worked out from the rock, and the dimensions of which have been given above, and which has been figured in Pl. XXVII, Figs. 3—7, and secondly, a fairly well preserved dorsal valve and a somewhat corroded ventral valve, still remaining in the rock. They all occur in the same piece of rock (*N:o 209*), in a white limestone,

with *Schwagerina princeps*, found as boulder at Sophus Müller's Naze (Eskimo dwelling-place, 80°55').

I name this new species after MYLIUS-ERICHSEN, the leader of the Danmark Expedition, who, during the course of the great sledge-journey towards the north, discovered this locality, afterwards called Sophus Müller's Naze, just where the two north-going parties separated from each other.

Spiriferina Mylii is very closely related to several of the species that have been described from the Carboniferous and the Permian beds, but, as far as we have been able to discern, it differs distinctly from them, both as regards the form and the sculpture. For example, the difference in form between our species and *Sp. nasuta* WAAGEN (1882—1884, Pl. 49, Figs. 1—2) is somewhat inconsiderable, but our form has more sharply defined ribs and more vaulted valves. *Spiriferina Panderi* MÖLLER, which TSCHERNYSCHEW (1902, p. 517, Pl. 37, Figs. 3—4) considers as also including WAAGEN's *Sp. nasuta*, has the tongue-like expansion of the anterior edge of the ventral valve so distinct, that the outline of the shell forms a triangle with inflexed sides. *Sp. Welleri* GIRTY (1908, Pl. 14, Figs. 17—19), has the form of the shell in fairly close agreement with ours, but both the arching and the sculpture are very different, which latter feature, in the case of the other species before mentioned, also differs considerably from that of *Sp. Mylii*.

The writers who have discussed this genus thoroughly have divided it into groups, each possessing some typical species, and for our species we find room in the group which, by WAAGEN and TSCHERNYSCHEW is characterized by *Sp. insculpta* PHILL., and by GIRTY in the section, "lamellosæ" which comprises the groups characterized by *Sp. Billingsi* SHUM. and *Sp. transversa* M'CHESN. The species which the writers in question refer to the groups mentioned differ very considerably from our species as regards the general form, etc. On the other hand, the figuring of the shell-sculpture of *Sp. Billingsi*, given by GIRTY (1908, Pl. 14, Fig. 16), is in perfect agreement with *Sp. Mylii*.

A species which, in many points, agrees with *Sp. Mylii* is *Sp. salemensis* WELLER (WELLER 1914, p. 296, Pl. 36, Figs. 1—5) from the Salem limestone in Illinois. This species has a broader shell, and a narrower mesial sinus and median rib than ours, but, otherwise, the profile of the shell and the structure of the cardinal area especially, present a great analogy to that of *Sp. Mylii*.

As regards the size of the shell, it should be pointed out that *Sp. Mylii* is one of the largest species hitherto described.

Spiriferina sp.

In boulders of a highly silicified limestone, recalling the Productus flint of Spitzbergen, and obtained at the Eskimo Naze, there occur some brachiopod remains which can probably be referred to this genus, but, in consequence of the slight amount of material available, this cannot be determined with certainty.

In boulder *N:o 205* there are found impressions of two dorsal valves, one almost perfect, with a length of 10 mm., the other fragmentary, belonging to a larger specimen. In this form the beak has projected considerably beyond the curved hinge-line. The valve has had a markedly vaulted median rib, with about 5 ribs on each side of this. The sculpture cannot be seen with clearness on the cast, but it has not been laminated, as, in the cast, only some few isolated striæ of growth could be observed nearest the anterior margin of the valve.

Among the species of *Spiriferina* that I have had the opportunity of seeing figured, there is none — neither from England, Russia, nor India — that has the beak of the dorsal valve projecting so far beyond the hinge-line. The species in which the beak projects most is *Sp. evax* GIRTY (1908, Pl. 13, Figs. 22—22 d), but still not to the extent found in our specimen.

In boulder *N:o 210*, there is a mould of a dorsal valve of a *Spiriferina*, about 12 mm. broad and 9 mm. long. The valve is rounded and provided with 9 ribs of which the median rib is comparatively little prominent among the others. On the mould the ribs appear narrower and sharper than would be the case in specimens with the shell preserved.

In spite of the very defective condition of preservation, our specimen can very well be compared with certain figurings of *Spiriferina cristata* v. SCHLOTH., but still, I consider it would be too daring to identify it with this variable species. *Sp. cristata* v. SCHLOTH. occurs in Russia from the Cora horizon inclusive, up to the Permian.

Spirifer or Spiriferella sp.

Pl. XXVII, Figs. 8—9.

Among the fossils that were obtained free-lying on the mainland behind Henrik Kröyer's Islets, there were also found some silicified brachiopods — all ventral valves belonging to the genus *Spirifer*, or, more probably, its sub-genus *Spiriferella*. Several of these were worked out by means of dilute hydrochloric acid, and I succeeded by this means in obtaining a view of the interior of these ventral valves.

Although they cannot be identified with any species previously described, I have wished, however, to figure and mention them.

Fig. 8 shows a ventral valve which, both as regards form and the interior structure, recalls very closely younger specimens of *Sp. polaris* WIMAN (Pl. IV, Figs. 5—7), which, however, are somewhat smaller (15—23 mm. in width) than our specimen, which measures about 40 mm. in width.

Fig. 9 shows a somewhat imperfect specimen of a form which is characterized by a specially high area, and very powerful cardinal teeth, supported by faintly developed dental plates, and with, in general, a very compact umbonal part. The internal structure of the valve agrees very well with the type that TSCHERNYSCHEW describes in such detail in *Spiriferella saranæ* VERN. (1902, pp. 522—526).

In addition to the specimens figured, there are two fragments of ventral valves closely related to that shown in Fig. 9, and certainly belonging to the same species as that, and also a rolled fragment of a form which bears a greater resemblance to the original of Fig. 8. It also recalls the rolled specimens of the umbonal part of *Sp. polaris* that WIMAN figures in Pl. V, Figs. 1—4.

Fig. 8 pretty certainly belongs to a species nearly related to *Sp. polaris* WIMAN, but I dare not express any opinion as to the relationship to the form figured in Fig. 9. *Sp. polaris* is one of the commonest species in the Carboniferous deposits of Spitzbergen and Beeren Eiland.

N:o 5. Spirifer n. sp.? ex aff. Sp. duplicicostæ Phill.

Pl. XXVII, Figs. 10—11.

This form, which is represented only by one specimen of a ventral valve found in a boulder in the Cape Jungersen section (*N:o 111*), stands probably nearest to *Sp. duplicicosta* PHILL. and *Sp. Wynnei* WAAGEN, but differs so considerably from both that I do not consider that I am able to refer it to either of these species, even as a variety. On the other hand, the form does not appear to me to be sufficiently sharply characterized, nor the material, either, rich enough to justify my giving a special name to this form.

The valve is oval; the length somewhat less than the width; the greatest width of the valve somewhat greater than the hinge-line. The valve is fairly evenly arched from the anterior margin to the beak, which is bent somewhat beyond the high cardinal area. The beak is greatly compressed and projects from the lateral portions of the valve, which slope sharply towards the angles of the valve. From the beak there runs a fairly deep and moderately broad sinus

down to the front-line; the margins of the sinus towards the lateral portions of the valve are not quite sharp, but the sinus retains approximately the same width on the anterior two-thirds of the valve, increasing somewhat in depth, however. In the sinus there are visible 6 ribs. On the lateral portions there are about 25 fairly coarse ribs, irregularly in direction, which decrease in distinctness and strength outwards. On the anterior portion of the valve, new ribs intercalate between the older ones, and the ribs are indistinctly united into 5 bundles, which also grow less distinct outwards. In one or two places, the ribs are intersected by ridges of growth, and in these places the irregularity of the ribs becomes still clearer.

Dimensions: Length 36 mm., width 41 mm., length of hinge-line 34 mm., height of area about 10 mm.

Our form differs from *Sp. duplicicosta* PHILL. as figured by DAVIDSON, by the height of the cardinal area and the great projection of the umbo beyond the hinge-line, while it is distinguished from *Sp. Wynnei* WAAG. by its greater width and by the sculpture, *Sp. Wynnei* having more regular ribs, which are not united into bundles. Here it should be noted that DIENER (1897 Part III. Pl. 7, Figs. 1—4) figures specimens of *Sp. Wynnei* from the Himalayas which have a lesser width than WAAGEN's *Sp. Wynnei*, and he remarks that, in some few specimens, the shell is as high as it is broad.

N:o 6. Spirifer cfr. striatus Martin.

Pl. XXVII, Figs. 12—13.

For synonyms see TSCHERNYSCHEW, 1902, p. 137.

A little specimen of a *Spirifer*, found free-lying at the Eskimo dwelling-place at Sophus Müller's Naze (*N:o 179*) must, in spite of its small size, be proximately referred to *Sp. striatus*, as it presents definite differences from other species belonging to the same group, such as, *Sp. fasciger* KEYS., *Sp. cameratus* MORT., *Sp. Marcoui* WAAG., etc.

Dimensions: Length 18 mm., width 25 mm.

The form of the shell, with the umbo projecting beyond the hinge-line, the circumstance that the sinus (which, however, is less accentuated than is usually the case with *Sp. striatus*) passes, without a sharp limit, into the lateral portions, and the character of the sculpture, in which the very fine ribs, about 10 in the sinus and 15 on each side, are indistinctly gathered into bundles, are all characteristics that refer this specimen to *Sp. striatus*.

Our specimen agrees fairly well with younger specimens from the Mountain Limestone of England, shown by DAVIDSON in Pl. 2,

Figs. 9, 10 and 11, while some great difference exists between it and the adult specimens he has figured; these have, especially, the ventral valve more strongly arched, and the sinus deeper.

This species has its principal occurrence in the Sub-Carboniferous deposits, but it also occurs, although very rarely, in the Urals, in the Schwagerina level, and in India, in the lower part of the Productus limestone. These forms, too, present some slight differences from the typical Sub-Carboniferous form; thus TSCHERNYSCHEW states that his form from the Urals has the sinus somewhat narrower, and WAAGEN states that the form from the Salt Range has a flatter ventral valve than the European forms.

Our specimen agrees more closely with the form from the upper Carboniferous beds, especially the Indian, while TSCHERNYSCHEW's figure, which shows an older specimen of about 75 mm. in width presents some difference, especially that the sinus is somewhat narrower. The figure of *Sp. striatus* that agrees most nearly with our specimen, is WAAGEN's Fig. 5 b, Pl. XLIV, which, however, shows a very young specimen of 18 mm. width.

It is possible that one could unite these forms of *Sp. striatus* from the Urals, the Salt Range and North-east Greenland, which occur in younger deposits, as a variety of *Sp. striatus* MART., as they really agree very closely with each other.

N:o 7. Spirifer supramosquensis Nik.

Pl. XXVII, Figs. 14—16.

For synonyms see TSCHERNYSCHEW, 1902, p. 155; WIMAN, 1914, p. 47.

This species is the brachiopod form that is most numerously represented in the Lower Marine group in North-east Greenland. Of this species, 7 specimens have been obtained from the Mallemukfjæld — 4 of them under *N:o 190*, and 1 each under *N:os 192*, *152* and *157*. The six first-named were found in the solid rock of bituminous, marly limestone, and represent only the ventral valve. The last (*N:o 157*) was found free-lying and is inbedded in the fine-grained reddish limestone, which is so common in the Lower Marine group. This specimen has both valves preserved, but is so greatly compressed that, unfortunately, it does not give any reliable information.

No fully reliable specimen of this species occurs from the localities on Amdrup's Land, but a little piece of the umbonal part of the ventral valve of a *Spirifer* (*N:o 161*) can scarcely belong to any other species.

The species belonging to the *Sp. mosquensis* group are so closely

related to each other, that, in many instances, it is difficult to distinguish them from each other, and a thorough revision is probably required, especially of the 3 species, *Sp. supramosquensis* NIK., *Sp. Fritschi* SCHELLW. and *Sp. Nikitini* TSCHERN.

The specimens from North-east Greenland which are at my disposal are not so well preserved that they can throw any light over the other species, but I have to be contented with establishing their proximate relationship with *Sp. supramosquensis,* and their difference from the other forms, such as these have been described.

They are fairly easily distinguished from *Sp. mosquensis*, first by the dental plates and secondly by the sculpture.

As shown by Fig. 16, the dental plates, which are almost straight, do not reach farther in the shell than to somewhat beyond its middle, while those of *Sp. mosquensis*, where the plates form convex arcs with the median line of the shell, reach to $^3/_4$ or $^4/_5$ of its length The best illustrations of the interior of *Sp. mosquensis*, which are found, both in TRAUTSCHOLD (Pl. XXXVII, Fig. 1—2), and in FRECH (Lethæa palæozoica, Pl. 47 a, Fig. 5 as new figures after TRAUTSCHOLD's original), are in want, both of any statement of dimensions or of any hint as to the outline of the complete shell, so that, by their help, it is only possible to give an approximate estimation of the relative length of the dental plates. DE KONINCK (1883, p. 381, Pl. XIV, Fig. 11), states that the dental plates reach almost to the anterior margin of the shell, and his figures show this. HOLTEDAHL's statements point in the same direction.

The sculpture, as is seen by Fig. 14, shows dichotomy in the case of several of the ribs, which is not the case with *Sp. mosquensis.*

We meet with greater difficulties, on the other hand, when endeavouring to decide whether our specimens shall be referred to *Sp. supramosquensis*, *Fritschi* or to *Nikitini;* between the first two of these species, especially, the difference has not been very clearly pointed out, and it is only gradually that this has been done. *Spirifer Fritschi* was established as a distinct species by SCHELLWIEN (1892) but, later on (1894, p. 75, Foot-note), the same author has expressed his doubts as to the correctness of giving *Sp. Fritschi* as a distinct species, and has supposed it to be identical with *Sp. supramosquensis.* In Lethæa palæozoica (1897—1902) FRECH takes these two species as identical, so that his comparison between *Sp. mosquensis* and *Sp. supramosquensis* NIK. cannot be admitted as evidence. As far as I can see, FRECH, for his figuring of the latter, has probably employed both *Sp. supramosquensis* and *Sp. Fritschi* as originals (Pl. 47 b, Fig. 1 a; and the Fig. in the text, p. 260, *Sp. Fritschi* from the

Auernigg beds in the Carnian Alps, and Pl. 47 b, Fig. 1 b, possibly *Sp. supramosquensis* Nik. from Nova Zembla; the piece is an original figured also by Toula, but as *Sp. mosquensis*).

Schellwien has later on (1900, pp. 71—72, text-figs. 10 and 11) more definitely pointed out the difference between *Sp. Fritschi* and *Sp. supramosquensis*, and has described it, while referring to Russian specimens of *Sp. supramosquensis*. He gives as a specific characteristic of *Sp. supramosquensis* the shape of the sinus of the ventral valve, which possesses a markedly deeper groove in the middle of the otherwise somewhat shallow depression that the sinus forms. This characteristic has been observed by Wiman too in specimens of *Sp. supramosquensis* from Beeren Eiland. This feature alone, however, is not sufficient to characterize *Sp. supramosquensis*, as *Sp. Nikitini* Tschern. also possesses a sinus of the same shape, which Schellwien gives as distinctive for *Sp. supramosquensis*. Tschernyschew, in his description of these two species, does not mention this deepening of the sinus, but gives, as the characteristic features, the form of the shell, and the height and width of the cardinal area.

Sp. Fritschi is the broadest of these three species, with the width of the shell considerably exceeding the length, and with the cardinal area almost equal to the greatest width of the shell, fairly low, and provided with a peculiar sculpture; the beak is abruptly pointed and projects only inconsiderably beyond the hinge-line. *Sp. supramosquensis* and *Sp. Nikitini* are probably very nearly related, the length and width of the shell are approximately equal, in both species the hinge-line is shorter than the greatest width of the shell, but, in consequence of the beak in *Sp. Nikitini* being higher and very sharply pointed, the cardinal area in this species is both higher and narrower than that of *Sp. supramosquensis*; in *Sp. Nikitini* it occupies about one-half of the greatest width of the shell, while, in the case of *Sp. supramosquensis*, it occupies about two-thirds.

As regards the interior structure of the shell, Tschernyschew points out that *Sp. supramosquensis* and *Nikitini* agree in respect to the "geraden, verkürzten Zahnplatten", and that *Sp. Fritschi* and *Sp. supramosquensis* can, with sufficient positiveness, be distinguished from each other by means of the interior structure of the shell. He does not, however, point out any special characteristic features. If, however, we compare Schellwien's figure (1892, Pl. V, Fig. 8) of the internal structure of *Sp. Fritschi* with Fig. 16 and Nikitin's description of the internal structure of the shell of *Sp. supramosquensis*, one can no longer feel any doubt as to the importance of this difference.

The ventral valves which I refer to *Sp. supramosquensis*, closely agree, as shown by the figures and the brief description given below, with the earlier figurings of *Sp. supramosquensis;* the one detail which can, proximately, give rise to any doubt is that of the dimensions. NIKITIN's figures give a length of 31 and 37 mm., and SCHELLWIEN's text-figures give 28 and 47 mm., but as no scale-measurement is given for any of these figurings, we are probably entitled to consider them as drawn to natural size. The specimens given by WIMAN attain a height of only 16 mm The North-east Greenland specimens, as a rule, have larger dimensions; as, however, the anterior margin is defective in every instance, the length can only approximately be determined, this being, for the six specimens, 72, 60, 50, 45, 35 and 31 mm. *Sp. Fritschi* and *Sp. Nikitini*, on the other hand, attain dimensions more nearly in agreement with the specimens from Greenland, as SCHELLWIEN gives for the first-mentioned a greatest observed length of 55 mm. and WIMAN mentions a specimen from Cape Fanshave (Hinlopen Strait) Spitzbergen, 68 mm. in length. In the case of *Sp. Nikitini*, the length of the largest specimen figured amounts to 53 mm.

As regards form, the North-east Greenland specimens agree very well with the illustrations given of the species, and, in this matter, too, it can be observed that younger specimens present a greater width than length (in the case of *Sp. Nikitini*, the opposite appears to be the case); in the oldest specimens, the width is, probably, only slightly in excess of the length, while, in the younger specimens, the proportion between width and length can rise to 8 : 7 (SCHELLWIEN's text-figure 8 gives width : length 32 : 22). The greatest width of the shell lies approximately just between the anterior margin of the shell and the hinge-line; the width of the hinge-line amounts probably to about two-thirds of the entire width of the shell. The umbo is pointed and incurved, and projects considerably beyond the hinge-line. In consequence of the defectiveness of the specimen, no details can be given of the structure of the cardinal area and of the relation between the hinge-line and the lateral margins of the shell, a relation which might, possibly, afford further characteristic features for the determination of the species.

N:o 8. Spirifer Fritschi Schellwien.

For synonyms see TSCHERNYSCHEW 1902, p. 156; WIMAN 1914, p. 48.

In spite of the damaged state of the specimen, I consider that I ought to refer to this species a *Spirifer*, found on the shore at the Mallemukfjæld (*N:o 141*), in a boulder of the fine-grained reddish

limestone. Its agreement with both SCHELLWIEN's figures and TSCHERNYSCHEW's, which latter, it is true, is classified under the title *Sp.* cfr. *Fritschi* SCHELLW. (1902, Pl. 13, Fig. 1), and also with specimens from Spitzbergen, make me quite certain as to the determination.

The relation borne by the species to related forms, especially to *Sp. supramosquensis* NIK. has been dealt with in some detail under that species, but it will probably be found suitable if we pay some further attention to its occurrence in Arctic regions, and to the interpretation given by earlier writers to its presence there. WIMAN mentions the species both from King's Bay, from which locality he has had 3 specimens for examination, and also from Cape Fanshave (Hinlopen Strait), from which he has seen one specimen, which, however, he considers cannot be specifically determined.

On inspecting the Spitzbergen collections of the Swedish Riks-Museum, I found, however, two additional specimens of *Sp. Fritschi*, having on their label: "*Spirifer mosquensis*" (in the handwriting of the late Professor LINDSTRÖM), "Cape Fanshave" (in the handwriting of Professor JOH. GUNNAR ANDERSSON). These specimens from Cape Fanshave have formed the basis of the presumption of the occurrence of the mosquensis horizon in Spitzbergen of authors previous to HOLTEDAHL. WIMAN mentions something of the historical development and assumes a contradiction in the mention made by TSCHERNYSCHEW (1902, p. 688) of the specimens determined by LINDSTRÖM and JOH. GUNNAR ANDERSSON as *Sp. mosquensis*, as TSCHERNYSCHEW, when mentioning *Sp. Fritschi*, says "Exemplare", and only one then was at WIMAN's hands. WIMAN has not had these specimens for examination, but they confirm in a very high degree, the determination of *Sp. Fritschi* SCHELLWIEN from Spitzbergen.

N:o 9. Spirifer fulmari n. sp.

Pl. XXVII, Figs. 17—19.

I consider that I ought to classify as a new species a specimen of a *Spirifer* belonging to the *mosquensis* group, and obtained from the solid rock, 275 metres above sea-level in the Mallemukfjæld (*N:o 166*). I do so in consequence of the great difference it shows from the other species belonging to the above-mentioned group, in spite of the material being restricted to an isolated ventral valve which in addition, sufferred some damage during the life of the animal, which healed later on. The name of the new species has been given after the bird — *Fulmarus glacialis* — from which the Mallemukfjæld has obtained its name.

The ventral valve is greatly convex with rounded rectangular outline and a straight hinge-line, across which projects the short and broad, but strongly bent beak. The extreme point of the beak has been corroded away, so that it is not possible to give its appearance with certainty, nor to be quite sure as to the structure of the cardinal area. However, there are definite indications that the beak projected only inconsiderably backwards beyond the hinge-line; and the height of the cardinal area has been rather inconsiderable, or about 4 mm. The area increases gradually in height towards the middle of the shell, and forms an obtuse angle with the mesial plane of the shell. It is provided with a double sculpture, consisting partly of fine, horizontal striæ of growth, and partly of coarser, irregular vertical lines which almost give the impression of wrinkles. The beak occupies about $^1/_3$ of the length of the hinge-line. The hinge-line is long and straight, about $^9/_{10}$ of the greatest width of the valve, and passes, with evenly rounded corners into the lateral contours. The lateral portions of the valve slope fairly abruptly, forming, thereby, small ears, which are not clearly distinguished from the main part of the valve. The anterior margin of the valve forms a circular line. The width of the valve is somewhat greater than its length.

From the point of the beak to the anterior margin of the valve runs a narrow, grooved sinus, embracing about 3 of the ribs of the valve, and which only gradually increases in breadth and also becomes somewhat flatter; the sinus causes some little inflexion of the anterior margin.

The valve is ornamented with close-lying ribs, pretty flat, of varying breadth, and with a distinct groove between them which diminish in intensity towards the flanks, and also by exceedingly fine, straight striæ of growth. On each side of the sinus there can be counted 40—50 ribs; in the umbonal region the ribs lie more closely together and are fewer in number, and some few dichotomies are observable there.

The interior of the ventral valve shows a pair of well developed but relatively thin dental plates which descend almost direct down towards the anterior margin of the valve to about $^4/_5$ of its length. The dental plates diverge considerably from the wall of the shell towards the interior, as is clearly seen by Fig. 19, where the dental plate to the left is seen to be considerably more distant from the mesial line of the valve, the reason being that that part of the fossil which is visible to the left, has been less corroded and dissolved than that to the right.

Dimensions: Length about 43 mm., width about 45 mm., length

of the hinge-line 40 mm., thickness of the ventral valve about 19 mm.

By the internal structure of the valve and its well developed dental plates, this species must, most undoubtedly, be referred to that group of *Spirifers* characterized by *Sp. mosquensis*, but it is distinctly differentiated from all the other species belonging to the group by its fine sculpture. The species to which *Sp. fulmari* bears the greatest resemblance is *Sp. Fritschi* which possesses the same general form but, in addition to its characteristic sculpture, *Sp. fulmari*, differs from *Sp. Fritschi* by its greatly convex shell, its powerful and greatly projecting beak and its weak sinus.

N:o 10. Spirifer rectangulus Kut. var. alta, nov. var.?

Pl. XXVIII, Fig. 1—6.

The three specimens — differing somewhat from each other — of a species belonging to the *Sp. trigonalis* group that form the present material, it has been impossible to identify with certainty as belonging to any species previously described; neither, from the material at hand, have I been able to establish a new species, especially as the species which belong to this group present rather great limits of variation.

The designation chosen above for the form now in question, indicates that I am most inclined to refer it as a variety to *Sp. rectangulus* Kut., although, in certain respects, it considerably exceeds the limits for variation which we, in accordance with Tscherny-schew's wealth of illustrations (1902, Pl. VIII, Fig. 1; Pl. XLI, Figs. 1—5, pp. 545—548) should consider as appertaining to this species. Frech's (1900, Pl. 47 c, Fig. 7) figuring of *Sp. rectangulus* Kut., from Almasnaja, at Donetz, points rather to a variation in the same direction as these specimens from North-east Greenland. In Stuckenberg, too (1905, Pl. 3, Figs. 3—7) there are figured specimens of *Sp. rectangulus* Kut. which have the variation of a higher shell and a greatly rounded anterior margin.

For the sake of comparison, therefore, all three specimens have been figured here: Specimen I, Figs. 1—4, shows a wider form; specimen II, Fig. 5, presents a considerably longer form, but, as shown by the course of the striae of growth, it proves to stand in connection with the broader form, so that the shell's greater length has increased with age. Specimen III, Fig. 6, agrees in form pretty well with the preceding, but the shell is so weathered that the sculpture is indistinct, nothing being visible of the striæ of growth, especially.

The dimensions of the three specimens are as follows:

I. width 34 mm., length 23 mm.: width : length = 100 : 68
II. — 32 — — 26 — — : — = 100 : 81
III. — 40 — — 33 — — : — = 100 : 82

The description given below refers to specimen I, and the variations from this form presented by the other specimens, are then given separately.

The outline of the shell forms, approximately, a parallel trapezium. The ventral valve is evenly arched, with the beak rapidly tapering off, with an involute, blunted point projecting beyond the hinge-line. The hinge-line is equal to the greatest width of the shell, and from the angles of the shell the outline goes in an even, flattened arc to the anterior margin of the shell, where the sinus forms a shallow inflexion. In the umbonal region the sinus is deep and its margins well marked; it increases in width anteriorly and, at the same time, becomes shallower, so that it passes more and more into the lateral portions. The cardinal area is moderately high with almost the same height in its whole width, and is limited towards the shell by a clearly marked elevated ridge. Towards the interior of the shell the edge of the area is bent upwards, so that the area forms a groove. It has possessed an evident horizontal sculpture of fine striæ, the greater part of which, however, disappeared on working out; it is uncertain if any vertical sculpture existed; on the inner side of the edge of the area there is visible a faint crenulation.

The shell is ornamented with rounded ribs of almost uniform size; in the umbonal region there are seen only 3 ribs on each side of the sinus and, on the anterior margin there can be seen 8, which gradually vanish towards the sides. The sinus, in which are visible 3 ribs of almost equal size, is separated from the lateral parts by a specially prominent rib. On the ribs there is seen a very fine radial sculpture which, together with the faintly undulating striæ of growth, form an imbricate sculpture as shown by Fig. 4. The faint striæ of growth are, in certain places on the anterior part of the shell, bunched together, becoming thereby more prominent, but on the posterior part too of the shell they can be clearly seen when magnified, so that it is possible to follow the growth of the shell. It is then clearly seen that, with the growth due to age, a certain definite alteration of form of the shell has taken place, so that the shell, in the younger stages, has pointed wings, and considerably less length than the grown shell. From the striæ of growth it can be determined that the proportion of length of shell to the width of the hinge-line should be as follows:

Width	34	mm.,	length	23	mm.:	width	:	length	= 100 : 68
—	30	—	—	15	—	—	:	—	= 100 : 50
—	26	—	—	11	—	—	:	—	= 100 : 41
—	16	—	—	6	—	—	:	—	= 100 : 37.5.

Fig. 1 shows these shell-contours.

The differences from specimen I, described above, occurring in specimens II and III, are briefly, as follows. Sp. II possesses a broader and deeper sinus which is sharply limited from the lateral portions of the valve; sp. III has the sinus relatively broad and shallow, and passes fairly evenly into the lateral parts of the valve. As far as regards the ribs of the sinus, sp. II appears to correspond perfectly with sp. I, while, in the case of sp. III, the sinus in the posterior part of the valve seems to have 3 ribs and, in the anterior part, 5; both specimens show fairly clearly that, of the wings occurring in the juvenile stages, there have been formed well developed ears.

The specimen I described above is in very close agreement with Tschernyschew's Figs. 3 and 4, Pl. XLI, which figure younger individuals, but the North-east Greenland specimen attains only $^2/_3$ the size of the specimens from the Urals. The older specimens figured by Tschernyschew — Pl. XLI, Fig. 1, for example, differ considerably from our sp. I, and still more from our older specimens, II and III. The above-mentioned figure possesses, with a width of 80 mm., a length of 35 mm., which gives a proportion of 100 : 44. In the shell-sculpture, too, it presents considerable differences, as it has much coarser ribs, which, in general, are doubled. Tschernyschew compares these older specimens with *Sp. grandicostatus* M'Coy.

A comparison with Tschernyschew's figures shows that the only difference between our form and his figures of specimens from the Urals are, in addition to the dimensions, the general contour which, during growth, alters in a specially distinctive manner. In the juvenile stages, the form of the shell agrees fairly well — judging by the striæ of growth on Tschernyschew's figures, at least — and, in the form from the Urals, the superiority of width over length is retained during the entire period of growth, in about the same proportions.

Of allied species, special mention may be made of *Sp. trigonalis* Martin, but a comparison with de Koninck's figures at once shows the fairly great difference, both in sculpture and form. Another species, to which one would be more inclined to refer these Greenland specimens, might be *Sp. Strangwaysi* Vern., but, from Trautschold's figures (Pl. XXXV, Fig. 4) which, it is true, are not very successful, the differences are of sufficient importance to allow us

to distinguish our form from the species mentioned. *Sp. Strangwaysi* is of considerably less thickness, and has a larger number of ribs — 10 to 14 on each side of the sinus — which continue to the edge of the shell.

Our specimens are derived from the bituminous limestone (*N:o 190*), at a height of 200 m. above the sea, in the Conglomerate section.

Spirifer sp. indet. 2.

Of undeterminable *Spirifer* fragments we consider that we ought to mention two specimens of wide forms.

The one, which is silicified, was found on the mainland behind Henrik Kröyers Islets (*N:o 206*) and belongs to a species with a very wide shell, about 3 times as wide as it is long; the shell is rather flat, with 12—15 flattened ribs on each side of the shallow sinus, which, at the anterior margin, is almost half as broad as the length of the shell (which was about 20 mm.).

The other is a cast of a shell preserved in a free-lying boulder of limestone (*N:o 153*), found at the Mallemukfjæld. The fragment shows only the one flank of the shell, but points to its being a specimen with a width of approximately 60 mm., the width being somewhat more than 3 times as great as the length. The shell has had 10—12 flattened ribs on each side of the sinus and sinuous, imbricate striæ of growth. This sculpture, as well as the form of the shell, points to a relationship with that group of *Spirifers* that includes the Sub-Carboniferous *Sp. triangularis* MARTIN, *Sp. Dieneri* TSCHERN. from the Schwagerina horizon of Russia, and the Permian *Sp. alatus* v. SCHLOTH.

N:o 11. Martinia coreulum Kut.

For synonyms see TSCHERNYSCHEW 1902, p. 180.

A few specimens of smooth brachiopods have been found in a free-lying boulder of red limestone (*N:o 168.2*) obtained at the foot of the Mallemukfjæld, and very much recalling the red limestone found in many places in the lower part of the profiles, e. g., west of Koch's section. They should, probably be referred to the species above-mentioned.

These specimens are rather badly preserved, and only two give any reliable evidence as to the relationship of the form to the species as formerly described. But these two specimens, too, are incomplete at the anterior margin. It should seem, however, as if our specimens were somewhat wider than TSCHERNYSCHEW's figures

(Pl. 15, Figs. 6—7); the size, too, is different, the specimens in question attaining a width of only 11—13 mm., while TSCHERNYSCHEW's figures have a width of 18 mm.

N:o 12. Reticularia lineata Martin.

For synonyms see TSCHERNYSCHEW 1902, p. 193.

In the free-lying boulder *N:o 154*, of fine-grained, light limestone from the Mallemukfjæld, there was obtained an imperfect specimen af a ventral valve, with the umbonal region and the area well preserved, which I consider I can refer to this species. The specimen when entire has measured about 22 mm. in width, 17 mm. in length and 12 mm. in thickness.

The species is widely distributed, both horizontally and vertically.

N:o 13. Strophalosia sp. indet. N:o 1.

Pl. XXVIII, Fig. 7.

A specimen of a *Strophalosia*, which I did not succeed in working out from the rock, will now be described, in spite of the fact that it is impossible even approximately to determine its relationship to forms already described. The stratigraphical distribution of the genus *Strophalosia*, however, is so definite, appearing first in any great number in the Upper Carboniferous beds, and with its greatest distribution in the Permian formation, that the occurrence here of its species is worthy of mention.

In form, the shell is rounded triangular, with the length and width equal, and with the greatest width near the anterior margin. The ventral valve is fairly evenly arched, the arching being increased in the anterior portion; there is visible here a very faint sinus, too. The dorsal valve is concave, adhering pretty closely to the form of the ventral valve and, consequently, giving a fairly small visceral room. The length of the shell is about 18 mm., the width being about the same; the thickness of the shell is about 7 mm., and the distance between the valves about 4 mm. The hinge-line is straight and fairly short (about 6 mm.) and the beak has probably been truncated and did not project beyond the hinge-line. The shell is characteristically sculptured; the ventral valve is covered with 2 to 4 mm. long spines which seem to be arranged in radiating rows with intermediate spaces of from 1½ to 2 mm. distance, while in the rows themselves, the spines have a distance from each other of about 2 mm. The spine-bases are almost circular, forming a minute pustle. The dorsal valve is irregularly wrinkled, and is provided with very fine striæ of growth.

The specimen occurs in a free-lying boulder (*N:o 203*) of the fine-grained limestone from the Eskimo Naze; there is also another specimen, probably of the same species, but almost concealed by the rock. Of other fossils, the boulder contains only *Alveolites* sp.

Of the species accessible to me in the literature, the species that appears to offer the greatest analogies to our specimen, is *Str. Cornelliana* DERBY, which, however, has often grown fast, throughout the whole of its length, with its growing-bed. (1874, p. 45; Pl. 3, Figs. 28, 30, 32, 33, 35, 36, 37, 38; Pl. 4, Fig. 5; Pl. 8, Figs. 1, 17; Pl. 9, Figs. 10—11).

N:o 14. Strophalosia sp. indet. N:o 2.

Pl. XXVIII, Fig. 8—9.

A specimen of the ventral valve, chiefly a mould with a small fragment of the shell, obtained from the fine-grained limestone *N:o 154*, from the Mallemukfjæld, ought probably to be referred to the genus *Strophalosia*, even though with some hesitation.

The valve is triangular, rounded anteriorly; the height 12 mm. and with the greatest width somewhat less, being 11 mm. immediately behind the anterior margin. The greatest arching of the valve is at the irregularly formed beak, whence the valve slopes fairly sharply towards the flanks, and more gently towards the anterior margin. The hinge-line is about 5 mm. long and is almost straight. The sculpture of the shell consists of finely radiating ribs on which, here and there, a spine has been attached, starting from an elongated base. On the poorly developed ears and on the flanks nearest to the beak, the spines have been most numerous. Of concentric sculpture the valve has had only weak, irregular wrinkles, most accentuated on the umbonal part and vanishing towards the anterior margin.

Among the figures and descriptions of species belonging to the genus *Strophalosia*, to which I have had access, especially in WAAGEN and NETSCHAJEW, I have not been able to discover any species with a similarly shaped valve, and, above all, there is none with a similar irregular umbonal portion. The distinct indication of an area below the hinge-line, and the evident scar of attachment at the point of the beak, I consider, however, as being good reasons for referring this form to the genus *Strophalosia*.

N:o 15. Chonetella nasuta Waag.

Pl. XXVIII, Figs. 10—14.

WAAGEN 1882—84, pp. 657—660, Pl. 81, Figs. 3—8.

ROTHPLETZ 1892, p. 77, Pl. 10, Figs. 12 and 16.

Of this characteristic form there is a specimen from the black bituminous limestone with *Spirifer supramosquensis*, in the Conglomerate section (*N:o 190*).

The specimen is complete, with the two valves attached to each other, but the dorsal valve has been concealed by rock substance which it has not been possible to entirely remove. In consequence of its state of preservation, it has been impossible to discern among the peculiar characteristics distinguishing the genus more than the little deltidial fissure below the beak. The spines on the hinge-line are also wanting, even if there exist indications that they have formerly been present, but that they have been worn away. There is no doubt, however, but that our form belongs to the above-named genus and species in question.

Our specimen is larger than those of WAAGEN (from one-half to once as large again), with a total length of 17 mm.; the width at the hinge-line about 20 mm., and the thickness 11 mm. As contrasted with the specimens figured by WAAGEN, our specimen presents certain marks of senility; this being specially visible in Fig. 13, which gives a lateral view of the shell. WAAGEN distinguishes two varieties of the species; the one strongly inflated, with small wings, and the other less strongly inflated, with larger wings. Our specimen belongs to the strongly inflated variety, and agrees fairly closely in form with WAAGEN's Figs. 7 a—d. Our specimen, however, has had its greatest width at the hinge-line, which, unfortunately, is somewhat defect, while WAAGEN's figure has its greatest width at the middle of the shell.

In the sculpture, our form presents certain small differences from WAAGEN's description and figure. The radial sculpture with ribs, the sinus and the nose-shaped projection at the anterior margin, are in entire agreement with the exception of some small lesions suffered by the shell during the animal's life, but which had healed again. A distinct difference, however, is that, in our specimen, the umbonal portion of the ventral valve possesses concentric wrinkles or rounded ribs, which are most evident pretty near to the umbo and decrease in strength anteriorly. The valve presents scars of spines in several places.

We do not wish to express any opinion whether these differences: the concentric sculpture on the umbonal portion and the richer occurrence of spines — are of such importance that they entitle us to add a variety to WAAGEN's species, as the material available consists of but one specimen, and as WAAGEN's description suggests that there exists a certain space of variation in the case of the Indian species.

WAAGEN describes this species from various parts of the middle and upper Productus limestone, and ROTHPLETZ mentions it from the Permian of the Indian archipelago.

N:o 16. Productús boliviensis D'Orb.

For synonyms see TSCHERNYSCHEW 1902, p. 250 and WIMAN 1914, p. 63.

Of this species there are two specimens, both found in free-lying boulders; the one at the Cape Jungersen section (*N:o 120*), and the other at the Eskimo Naze (*N:o 197*), both of them being of considerable dimensions.

The fragment from the Cape Jungersen section is fairly well preserved, and clearly shows the strong involution of the ventral valve, and the sharp projecting of the ears out from the umbonal part. Something is seen of the dorsal valve, too, suggesting its concave form and the small dimensions of the visceral room. The sculpture is somewhat indistinct, the shell being partially silicified.

The other specimen is, in several respects, fragmentary.

The species occurs in Spitzbergen, in the mosquensis limestone on the Brögger peninsula, and in Beeren Eiland in the Cora limestone. In Russia this species begins in the Cora limestone and goes up into the Arta stage.

N:o 17. Productus inflatus M'Chesney.

Pl. XXIX, Figs. 17—19.

For synonyms see WIMAN, 1914, p. 66; TSCHERNYSCHEW, 1902, p. 261 and STUART WELLER, 1914, p. 111.

I consider that to this species I ought to refer two specimens; the one found free-lying in the Cape Jungersen section (*N:o 128*), and the other free-lying at the Eskimo Naze (*N:o 212*).

The first, the figured is a large specimen, agreeing perfectly with those from Spitzbergen (Skansbay), and may specially be compared with the senile specimens figured by WIMAN, Pl. 14, Fig. 2, and Pl. 15, Figs. 3, 4. Our specimen also shows the dorsal valve (which however, has been displaced somewhat from its original position) with its characteristic sculpture of both concentric wrinkles and radiating ribs (see TSCHERNYSCHEW, 1902, Pl. 28, Fig. 4 c). The position and form of the dorsal valve points distinctly to a high visceral room. The ears are very large, so that, in our specimen — which, in general dimensions, is somewhat smaller than the WIMAN's specimen spoken of, but which, however, is equally senile in characteristics — they have attained a width, from point to point, of 75—80 mm.

The other specimen is smaller and not so well preserved, but this one, too, shows the characteristic of a high visceral room.

Specimens from Russia, Spitzbergen and North-east Greenland have, in general, the same dimensions, while those from North America, figured by STUART WELLER, are considerably smaller.

The species is abundant in Spitzbergen and Beeren Eiland in the Spirifer limestone, and in Russia it goes from the Omphalotrochus horizon up into the Arta stage. In North America it occurs in the Mississipian (Chester Group).

Productus sp. indet. 2 (of the *semireticulatus* group).

Of forms belonging to the *semireticulatus* group, there have been found fragmentary specimens, all ventral valves: — 2 specimens in the grey, fine-grained limestone (*N:o 204*) found as free-lying fragments at the Eskimo Naze, and 2 specimens, each found in a boulder of the white "conglomerate"-like limestone from Eskimo Naze (*N:o 204*) and from the mainland behind Henrik Kröyer's Islets (*N:o 179*). There is some difference between these two types, each of which probably represents a species.

The first have the concentric ornamentation well developed and regular, so that the reticulate sculpture appears rather plainly. The specimens are fairly young, and show just a beginning of the geniculation of the ventral valve for the visceral room. The length is almost 30 mm.

The latter have the concentrical sculpture less sharp, appearing more in the form of wrinkles, so that the reticulate sculpture becomes fairly irregular. The specimens are somewhat compressed; this species has been of smaller dimensions than the former, as the ventral valve, with a length of about 20 mm., proves an evident geniculation.

N:o 18. Productus longispinus Sow.

For synonyms see FLIEGEL, 1901, p. 100.

Of this species, a ventral valve has been found 90 metres above sea-level on Amdrup's Land at the Eastern river, in a dark, somewhat crystalline limestone (*N:o 125*).

The specimen has a length of 13 mm., and a height of 17 mm. and belongs to that form of the species without sinus, and consequently has had the shell equally vaulted.

The agreement is very great between our specimen and those which SCHELLWIEN (1900, p. 56, Pl. VII, Figs. 4—7) mentions and figures from Teufelschlucht in Trogkofel and NIKITIN (1890, p. 159, Pl. I, Figs. 7—12), from the Gshel stage of the Russian Carboniferous.

Productus longispinus Sow. is a fairly variable form, of which a number of different species have been drawn up, but which DAVIDSON, however, groups together. Its stratigraphical distribution is, too, fairly wide, so that it can hardly make a very valuable contribution to the determination of the horizon. *Productus lobatus* Sow. which TSCHERNYSCHEW (1902, p. 263) mentions from the Omphalotrochus and Schwagerina horizons of Russia, is considered by DAVIDSON to be a variety of *Pr. longispinus* Sow.

N:o 19. Productus compressus Waag.

Pl. XXVIII, Figs. 15—18.

WAAGEN, 1882—84, p. 710, pl. 81. Figs. 1—2.

A specimen of a form appertaining to the *Pr. striatus* group, and found in the very fossiliferous limestone, *N:o 154* from the Mallemukfjæld, ought probably, although somewhat doubtfully, be referred to this species.

The forms belonging to the *striatus* group are fairly closely related to each other, and here, as in the case of the *Cora* group, GRÖBER denies that we are entitled to establish more than one species.

The specimen we have figured here is triangular in outline, and wants a proper hinge-line. Of the ears there remain only faintly discernible remains, which show that they have a direction vertical to the valve. The beak is pointed, and the umbonal portion strongly compressed.

The ventral valve has no indication of a sinus, and, from the beak it is arched in an even curvature, until it meets the concave dorsal valve where it bends sharply anteriorly. In consequence of this form of the shell, the visceral room becomes low and small.

The sculpture of the ventral valve is not preserved, as the valve, as is usually the case with this group, is very thin, but the mould clearly shows irregular wrinkles of the same form and appearance as those shown in WAAGEN's figure, although they are not so numerous. The mould also shows traces of about 4 spines on the one flank.

The dorsal valve is ornamented with fine striæ which increase in number through intercalation, and spread fan-wise over the entire surface of the valve, so that they meet the margin at about right angles.

The characteristics in which our specimen differs from WAAGEN's are: the size — the length, in specimens from the Productus limestone of the Salt Range reaching as much as 55 mm. — and also the arching of the ventral valve. This latter character is stated

by WAAGEN to be specially variable, and the specimens figured present little resemblance to each other but, in the description it is stated that sometimes the curve "remains rather flat in the apical region and then suddenly bends down to the front".

Our specimen exhibits evident differences from other forms belonging to the *striatus* group. *Pr. anomalus* KEYS. (figured in TSCHERNYSCHEW, 1902, Pl. LXIII, Fig. 10) and *Pr. mytiloides* WAAGEN have a more regular sculpture, with the longitudinal striæ straighter and more continuous, while the ventral valve is considerably flatter. *Pr. mongolicus* DIENER (1897: Part III, Pl. 4, Figs. 8—10 and 1899, Pl. 6, Figs. 7—8) agrees, perhaps, somewhat more closely with our specimen as far as size is concerned (an entire specimen is about 30 mm., in length) and in the general form and the arching of the shell, but it differs from it by the umbo projecting somewhat beyond the hinge-line, and also by its different sculpture which, in the case of *Pr. mongolicus* DIEN., consists of fairly distinct and regular radial striæ and close, sharp transverse wrinkles.

Prod. striatus FISCHER, as figured by DAVIDSON, has a sharper and more regular radial sculpture, while the shell is flatter.

N:o 20. Productus simensis Tschern.

TSCHERNYSCHEW, 1902, pp. 626—628, Pl. 35, Fig. 5; Pl. 55, Figs. 2—5.

A compressed specimen of the ventral valve of a finely striated *Productus*, found in the black shaly rock (*N:o 190*) in the Conglomerate section, at about 200 metres above sea-level, together with *Spirifer supramosquensis* NIK. and *Sp. rectangulus* KUT. var. *alta*, ought probably be referred to this species.

The specimen is too badly preserved to be figured, but from its character it may easily be discerned that it is most closely connected with the species mentioned above. Its elongated form speaks most decidedly against its being referred to *Prod. Cora* d'ORB. and the nearest related forms, and brings it into closest connection with *Prod. tenuistriatus* VERN., and *Prod. simensis* TSCHERN.

The absence of wrinkles on the flanks, and the abrupt involution of the valve near the beak speaks most for *Prod. simensis*, but the compression that the valve has undergone, makes it impossible to decide if its transverse profile in the anterior part possesses the elevation in the middle and the sharp slope towards the flanks, which are characteristic for *Prod. simensis*.

In this connection reference should be made to the doubts expressed by GRÖBER (1908 and 1909) respecting the value, from a stratigraphical point of view, that can be ascribed to *Productus Cora*

d'ORB. and related species: *Pr. corrugatus* M'COY, *Pr. lineatus* WAAG., *Pr. tenuistriatus* VERN., *Pr. simensis* TSCHERN. — and to his opinion respecting the relationship of these forms to each others. In 1908 (p. 220) he classifies both *Pr. tenuistriatus* VERN. and *Pr. simensis* TSCHERN. as varieties of *Pr. Cora* d'ORB. and denies TSCHERNYSCHEW's assertion that *Pr. Cora* d'ORB. is a species characteristic of the Upper Carboniferous. I cannot, of course, express any opinion on this matter, but, supported by the statements before me, I should like to point out that TSCHERNYSCHEW (1902, pp. 626—628) gives *Pr. simensis* as belonging to the Schwagerina horizon in the Urals, while GRÖBER (1908, p. 220), mentions it from the Lower Carboniferous in southern Tian-Schan. Consequently, if GRÖBER's identification of these two forms is correct, this form is of little importance for a closer determination of the niveau of these strata.

The related *Pr. Cora* is, in Beeren Eiland, found in the Cora limestone, and, in Spitzbergen, in the Cyathophyllum limestone (WIMAN, p. 69), and, possible, in the mosquensis limestone (HOLTEDAHL, 1911, p. 34).

N:o 21. Productus cancriniformis Tschern.

Pl. XXVIII, Figs. 19—22.

Pr. cancriniformis TSCHERNYSCHEW 1889, p. 283, Pl. 7, Figs. 32—33.
- — SCHELLWIEN 1892, p. 22, Pl. 8, Figs. 20—21.
- — DIENER 1897: Part III, p. 25, Pl. 4, Figs. 6—7.
- — DIENER 1897: Part IV, p. 31, Pl. 1, Figs. 7—10.
- — SCHELLWIEN 1900, p. 43, Pl. 9, Figs. 1—6.
- — TSCHERNYSCHEW 1902, p. 292, Pl. 52, Figs. 5—6.

The available figures show that this species varies pretty considerably, both with respect to the form of the shell, the proportion between length and width, the arching of the dorsal valve, and the occurrence of a sinus. Our specimens are all fairly large and attain at least the same size as those figured; the width, too, of the shell is fairly considerable, and almost agrees with the broadest of the specimens previously figured. The ventral valve is almost spirally involute and presents a fairly evenly arched curve; in this respect our specimens agree best with DIENER's (1897: Part IV) figures of specimens from the Himalayas, although, on the other hand, DIENER remarks that, in his material, broad forms are rare. The specimen given in Fig. 19 presents an indication of a sinus, something like that shown in SCHELLWIEN, 1900, Pl. 9, Fig. 4. The other specimens have the shell evenly arched. The dorsal margin and the ears are not perfectly preserved, but there is nothing that indicates variations from the typical form. The same may be said about the sculpture,

and it should, perhaps, be specially pointed out that the characteristic feature distinguishing *Pr. cancriniformis* TSCHERN. from the nearly related *Pr. Cancrini* VERN., viz., the continuation of the transverse wrinkles from the flanks of the shell across the median portion, is clearly apparent.

This species occurs in 4 fairly well preserved specimens of the dorsal valve, in the light limestone *N:o 154* from the Mallemukfjæld.

By TSCHERNYSCHEW and other writers, this species is considered to be a leading form for the Arta stage[1], the lowest portion of the Permo-Carboniferous of Russia, and is mentioned from the Auernigg strata of the Carnian Alps, which, by SCHELLWIEN is reckoned as the uppermost bed of the Upper Carboniferous. In the Himalayas, the species occurs in the Chitichun fauna, which DIENER considers as belonging to the lowest Permo-Carboniferous, and in the Productus shales from Kumaon and Gurwhal in the Niti pass — strata which DIENER refers to the Permian. From Spitzbergen, TSCHERNYSCHEW mentions the species from the Productus-bearing siliceous rocks, but WIMAN has only a line about this species.

Productus cancriniformis TSCHERN., in Russia, goes down into the Schwagerina horizon. This species should, therefore, even though its vertical extension is fairly wide, be one of the forms which here indicate a higher horizon of the formations now in question, and consequently it points to a Schwagerina horizon as the lowest possible level.

N:o 22. Productus Wallacianus Derby.

Pl. XXIX, Figs. 1—4.

1874, *Productus Wallacianus* DERBY, p. 57, Pl. 3, Figs. 46—48; Pl. 6, Fig. 5.

1902, — *Wallacei* TSCHERNYSCHEW, p. 270, Pl. 30, Fig. 8; Pl. 60, Figs. 19—23.

Two specimens of a *Productus* found in a light fine-grained limestone on the Eskimo Naze (*N:o 213*), a ventral and a dorsal valve, I consider I should refer to the above-mentioned species, in spite of the fact that the original figures are by no means very clear, even

[1] The manner in which FRECH mentions this species in "Lethæa palæozoica" (Vol. I, 2), is somewhat peculiar, and is worthy of mention. On page 655 he mentions the species as „eine Leitform der Arta-stufe", while, on page 358 b, in a later addition, he includes it among „stratigraphisch bedeutungslose Arten von langer geologischer Lebensdauer". This last opinion is based on SCHELLWIEN (of 1902), but, even if the importance of this species for the determination of levels in the Permo-Carboniferous and the Permian is not very great, still, for us it is an important leading fossil which indicates the Schwagerina horizon as the lowest point of comparison.

if they can be fairly well supplemented by the description belonging to them.

TSCHERNYSCHEW's figures give a considerably clearer picture of the species, and our specimens agree very well with them, especially the ventral valve — our Pl. XXIX, Figs. 1—2 — with TSCHERNYSCHEW's Pl. 30, Fig. 8. The only difference from the American form that TSCHERNYSCHEW emphasizes, is, that, on the lower part of the valve, the tubercles serving as the bases of the spines are somewhat elongated, a feature which is clearest evident on the mould, although TSCHERNYSCHEW also remarks about this, that a longitudinal extension in the case of these tubercles can also be observed in one of DERBY's figures (Pl. 6, Fig. 5). In our specimens, these tubercles are not fully round but somewhat greater in length than width, although they have not that swollen, oval form of *Productus spinulosus* SOW. (DAVIDSON, 1857—62, Pl. 34), to which species *Pr. Wallacianus* DERBY has been referred by SCHELLWIEN (1900, p. 49), while TSCHERNYSCHEW denies the identity.

Our specimens present a little difference from DERBY's description, the hinge-line being somewhat shorter than the greatest width of the shell. The case is the same in several of TSCHERNYSCHEW's figures, and DERBY's Fig. 5, Pl. 6 also shows an indication of the same feature. Another difference is that, in our specimens the hinge-line is faintly curved; this is especially noticeable on the dorsal valve. DERBY's figure 46, Pl. 3, indicates that the hinge-line there is straight, while in TSCHERNYSCHEW, especially in Pl. 60, Figs. 22—23 indicate a curving of the hinge-line which, however, is lesser than in our specimens.

As regards dimensions, the specimens from North-east Greenland agree with those given, both from Russia and from Brazil.

The species occurs in the Cora- and in the Schwagerina horizons in the Urals.

As to the identity of our species with the *Pr.* cfr. *Wallacei* from the mosquensis strata of Spitzbergen described by HOLTEDAHL (1911, p. 31, Pl. 5, Fig. 14), it is impossible to form any decided opinion based on HOLTEDAHL's description and figures.

N:o 23. Productus Lovéni Wiman.

Pl. XXVIII, Fig. 23.

WIMAN p. 72, Pl. 17, Figs. 12—18.

Of this species there is in a boulder of grey limestone (*N:o 204*) collected at Eskimo Naze, a fairly well preserved specimen, which, on splitting the rock, showed itself in such a way that both the dorsal and the ventral valve appeared as a cast, the visceral room

having been filled with calcite which could be worked away. In the same boulder there is visible on the surface the sections, filled with calcite, of two *Productus* shells which, with tolerable certainty, may be ascribed to this species. The figure shows the cast of the sculpture of the dorsal valve, a fragment of the latter and finally, a part of the calcareous mass that had filled the visceral room.

Our specimen agrees very well with WIMAN's figures, both as regards sculpture and form; a wax impression of the ventral valve shows the agreement still better. Our specimen has not reached such an age that a geniculation of the ventral valve towards the front line can be noticed, such as is pictured by WIMAN from older specimens.

This species occurs numerously in Spitzbergen in the white, sandy Spirifer limestone on Lovén's Mountain, and some likeness can be noted between the rock in which the specimen from North-east Greenland occurs, and the Spirifer limestone of Lovén's Mountain.

N:o 24. Productus punctatus Martin.

Pl. XXIX, Fig. 5.

For synonyms see TSCHERNYSCHEW, 1902, pp. 296, 297; GIRTY 1903, p. 368, FLIEGEL, p. 101 and THOMAS p. 303.

Of this species I have only the specimen figured, a dorsal valve, found on Amdrup's Land at the Eastern river in light-red limestone (*N:o 160*). In dimensions it attains the figures given for large specimens, and, on the whole, it agrees with, e. g., DAVIDSON's figuring, Pl. 44, Figs. 9 and 11. As regards the sculpture of the valve, no difference can be observed between our specimen and DAVIDSON's figure 10 b, Pl. 44, and the description that VAUGHAN (1906, p. 307) gives of the shell-sculpture of this species as compared with that of *Pr. pustulosus* PHILL. and *Pr. fimbriatus* SOW., is perfectly applicable to our specimen. VAUGHAN says: "In the type of *Pr. punctatus* the spine-bases are extremely numerous, small, and closely packed, three to four concentric rows ornamenting each concentric band (the spines which compose the uppermost row on each band are always longer than those of the lower rows)". On one piece of the surface of the valve there are visible spines still remaining, and spines are spread pretty abundantly in the rock.

This species is widely distributed, both horizontally and vertically. It seems to have its chief niveau in the Lower Carboniferous, but HOLTEDAHL (1911, p. 35) states that it occurs abundantly in the mosquensis limestone at King's Bay, in Spitzbergen, while TSCHERNYSCHEW mentions it both from the Omphalotrochus limestone in Timan, and the Schwagerina horizon in the Urals.

JAKOWLEW (1912, Pl. 4, Fig. 8), mentions this species from the Permo-Carboniferous (Arta stage) in the Donetz basin.

For the group of *Productus* of which *Pr. punctatus* is the type, STUART WELLER (1914, p. 138) has proposed the establishment of a new genus, under the name of *Echinoconchus*, and THOMAS the genus *Pustula*.

N:o 25. Productus pseudohorridus Wiman.

Pl. XXIX, Figs. 6—10.

WIMAN, p. 74, Pl. 17, Figs. 1—11.

Of this typical species there are 3 unquestionable specimens: one full grown, showing both the ventral and the dorsal valve (the figured), found in a boulder at the Eskimo Naze (*N:o 213*); a fairly full-grown specimen of a ventral valve found at the same place (*N:o 197*), while a young specimen was found on the mainland behind Henrik Kröyer's Islets (*N:o 214 d*). All these occur in the same rock, a light-grey, fine-grained, somewhat sandy limestone. There is, in addition, a ventral valve (*N:o 214 c*) from the mainland at Henrik Kröyer's Islets, which however, is not so well preserved as to allow of fully positive identification.

These specimens agree so closely with WIMAN's description that only unimportant additions need to be made. Specially deserving of attention is that Fig. 9 shows the correctness of WIMAN's supposition that, in the case of fully complete specimens, the greatest width lies somewhat in advance of the ears. The cast of the dorsal valve shows how deep this is, and the form of the mesial fold, which corresponds to the sinus of the ventral valve, as well as the even curving of the anterior part of the dorsal valve towards the margin without any geniculation at the limit of the visceral room.

In Spitzbergen, this species occurs in the Spirifer limestone and in the Productus flint.

N:o 26. Productus timanicus Stuckenberg.

Pl. XXIX, Figs. 11—16.

STUCKENBERG, 1875, p. 86, Pl. 1, Figs. 1—7.

TSCHERNYSCHEW, 1902, pp. 306, 638, Pl. 30, Fig. 5; Pl. 57, Figs. 1—6.

STUCKENBERG, 1905, p. 65, Pl. 6, Fig. 10.

WIMAN, 1914, p. 75, Pl. 17, Figs. 19—21; Pl. 18, Figs. 1—6.

This species is one of the fossils that occur most numerously in our collection, and is represented both by fairly young specimens and by fully grown ones, a fact which, at first, rendered identification difficult.

In the limestone boulder, *N:o 154* there are 3 fairly complete specimens of the ventral valve — 2 of them younger ones (figured here) and 1 older one. There are, in addition, 2 fragments of ventral valves. Of the dorsal valve, there is one imperfect specimen. In the limestone boulder, *N:o 197*, from the Eskimo Naze (together with *Pr. pseudohorridus* WIMAN) there are 3 partly fragmentary specimens of the ventral valve, 2 younger and 1 older; in the limestone boulder, *N:o 196*, also from the Eskimo Naze, a younger, fairly complete specimen of a ventral valve. From Henrik Kröyer's Islets there was obtained (*N:o 191*), an older specimen, partially silicified.

The available illustrations of younger specimens (STUCKENBERG, 1875, Pl. 1, Figs. 5, 6, 7, and TSCHERNYSCHEW, 1902, Pl. 57, Figs. 3 a, 3 b) do not spread sufficient light on the structure of the specimens in question, but both STUCKENBERG in his original diagnosis and TSCHERNYSCHEW state that the sinus of the ventral valve begins at the apex itself and gradually increases outwards towards the anterior margin and that ears are wanting in the young individual. Our figures, 11—13, shows plainly that no ears can be distinguished and that the hinge-line is straight and very short; here, too, we have one of the characteristics distinguishing the younger specimens from the older, viz., that the hinge-line becomes longer with age, just as the valve, in general, increases in width. In one respect, possibly, our specimens differ both from the Russian and those from Spitzbergen, viz., that, nearest the beak, the median portion of the ventral valve is rather greatly compressed, so that it abruptly rises above the flanks and increases rapidly in width. The specimen shown in Figs. 14—16, is older than the specimens which are designated by STUCKENBERG and TSCHERNYSCHEW as young. The oldest specimen obtained from North-east Greenland has a width of about 43 mm., but is not so strongly involute and, consequently, not so old as TSCHERNYSCHEW's oldest specimens, Pl. 57, Figs. 4, 5, 6, even if this specimen is not very much superior in width, its maximum in this respect being only 50 mm. The specimens from Spitzbergen are much wider (75—80 mm.) and yet at the same time they do not present by far such a degree of involution as that shown by TSCHERNYSCHEW's figures. For the sake of comparison, the reader is referred to WIMAN's Fig. 20, Pl. 17. In the above respects, *Pr. timanicus* probably presents a fairly considerable space of variation, so that the mentioned difference in the appearance of the species, as found in the several localities, might possibly be made the basis for distinguishing various types.

The dorsal valve found here has been of fairly considerable dimensions, the width being about 35 mm., without spines, and does

not lead to any addition to what WIMAN has already mentioned with regard to the dorsal valve.

This species is one of the most common in the Spirifer limestone of Spitzbergen, and also occurs in the same horizon in Beeren Eiland. In Russia it is specially general in the Timan district, beginning there in the Omphalotrochus horizon, and having its chief occurrence in the Schwagerina horizon. In the Ural district again it is rare, being found there in the Cora horizon and also in dolomites belonging to the Arta stage.

I have not been able to find any younger specimens among the material from Spitzbergen in the State Museum at Stockholm that has been determined by WIMAN, but among fragments which have been characterized by him as "undeterminable Productidæ" I succeeded in discovering some younger specimens of *Pr. timanicus*, which agreed perfectly with those from North-east Greenland. In the collection from Spitzbergen of the Geological Institute of Uppsala there were found no younger specimens that could throw any light over the question of the structure of the juvenile forms.

As to the possible occurrence of this species in the Arctic North America the reader may be referred to the detailed unravelling of this problem, that is given below, pp. 602—604, where, too, the literature dealing with the question is also mentioned.

Table of the Distribution of the Brachiopod Fauna on the Localities of North-east Greenland.

			Holm's Land				Amdrup's Land				
			1	2a	2b	2c	3	4	5	6	7
*		*Dielasma* sp.	..	..	..	..	..	+			
†	N:o 1	*Rhynchopora Nikitini* TSCHERN.	..	..	+						
†	N:o 2	*Camarophoria Karpinskii* TSCHERN.	..	..	+						
†	N:o 3	*Athyris Royssii* L'EVEILLÉ	..	..	+						
†	N:o 4	*Spiriferina Mylii* n. sp.	..	..	..	..	..	..	..	+	
†		— sp.	..	..	..	+					
†		*Spirifer* l. *Spiriferella* sp. 2	..	..	..	..	..	..	+		
†	N:o 5	*Spirifer* n. sp.? ex aff. *Sp. duplicicostæ* PHILL.	..	..	..	..	..	+			
†	N:o 6	— cfr. *striatus* MART.	..	..	..	..	..	..	+		
*	N:o 7	— *supramosquensis* NIK.	×	..	..	..	?				
*	N:o 8	— *Fritschi* SCHELLW.	+								
*	N:o 9	— *fulmari* n. sp.	×								
*	N:o 10	— *rectangulus* KUT., var. *alta* n. var.?	×								
†		*Spirifer* sp. indet. 2	..	..	+	..	..	..	+		
*	N:o 11	*Martinia corculum* KUT.	+								
†	N:o 12	*Reticularia lineata* MART.	..	..	+						
†	N:o 13	*Strophalosia* sp. indet. N:o 1	..	..	+						
†	N:o 14	— - — - 2	..	..	+						
*	N:o 15	*Chonetella nasuta* WAAG.	×								
†	N:o 16	*Productus boliviensis* D'ORB.	..	+	..	..	..	+			
†	N:o 17	— *inflatus* M'CHESN.	..	..	..	+	..	+			
†		— sp. indet. 2	..	..	+						
*	N:o 18	— *longispinus* SOW.	..	..	..	..	×				
†	N:o 19	— *compressus* WAAG.	..	..	+						
*	N:o 20	— *simensis* TSCHERN.	×								
†	N:o 21	— *cancriniformis* TSCHERN.	..	..	+						
†	N:o 22	— *Wallacianus* DERBY	.	..	+						
†	N:o 23	— *Lovéni* WIMAN	..	..	+						
*	N:o 24	— *punctatus* MART.	..	..	..	..	×				
†	N:o 25	— *pseudohorridus* WIMAN	..	+	..	..	..	..	+		
†	N:o 26	— *timanicus* STUCK	..	..	+	..	..	..	..	..	+

* indicates a species occurring in the Lower Marine Group.
† - - - - - Upper - -

The localities are the following:

Holm's Land.

1. The south coast from west to the Mallemukfjæld; mostly finds in situ.
2. Finds of boulders at the Mallemukfjæld and on Eskimo Naze.
   a. the coarse-grained limestone.
   b. the fine-grained —
   c. the silicified —

Amdrup's Land.

3. The south coast west of Cape Jungersen.
4. Cape Jungersen.
5. The mainland at Henrik Kröyer's Islets.
6. Sophus Müller's Naze.
7. Henrik Kröyer's Islets.

× indicates a species found in solid rock.
⊥ - - - boulders.

The Distribution of the Brachiopod Fauna on the two horizons of the Carboniferous deposits of North-east Greenland.

As shown by the table above, the Brachiopod Fauna consists of 24 species of determined forms, to which should be added the two species of *Strophalosia*, so that, for the purpose of this comparative survey we have 26 species, 9 of which occur in the Lower, and 17 in the Upper group. It should be specially observed that no forms are common to the two groups.

The Lower group contains the following species:

Spirifer supramosquensis NIKITIN.
— *Fritschi* SCHELLW.
— *fulmari* n. sp.
— *rectangulus* KUT. var. *alta* n. var.
Martinia corculum KUT.
Chonetella nasuta WAAG.
Productus longispinus SOW.
— *simensis* TSCHERN.
— *punctatus* MARTIN.

The Upper group contains the following species:

Rhynchopora Nikitini TSCHERN.
Camarophoria cfr. *Karpinskii* TSCHERN.
Athyris Royssii L'EVEILLÉ.
Spiriferina Mylii n. sp.
Spirifer n. sp. ex aff. *Sp. duplicicostæ* PHILL.
— cfr. *striatus* MARTIN.
Reticularia lineata MARTIN.
Strophalosia sp. indet. N:o 1.
— sp. indet. N:o 2.
Productus boliviensis D'ORB.
— *inflatus* M'CHESN.
— *compressus* WAAG.
— *cancriniformis* TSCHERN.
— *Wallacianus* DERBY.
— *Lovéni* WIMAN.
— *pseudohorridus* WIMAN.
— *timanicus* STUCK.

These fossils, however, are found so scattered throughout the profiles, and often in talus boulders, that we cannot positively assert, as regards these lists, that the fossils given in them belong to any determined geological horizon, but that they rather belong to a complex of beds which, stratigraphically, are not more nearly determined

than can be ascertained from the grouping laid down in the preceding general review.

If we wish to distinguish and collectively discuss forms that really belong stratigraphically to the same horizon, we must go further into detail, and give those fossils that have been found either in the same stratum at a definitely known level — with a definite and assured statement that they have been discovered in the solid rock — or else those fossils that have been found in the same boulder.

Of the fossils from the Lower group of beds, the following, therefore, are connected with each other, which were found at the same level in the bituminous limestone with the marl-shales: *Spirifer supramosquensis* Nik., *Sp. rectangulus* Kut., var. *alta* n. var., *Chonetella nasuta* Waag. and *Productus simensis* Tschern., i. e., 4 species of 8. All the others were found isolated.

Of the collections belonging to the Upper group, the specimens *N:o 154*, from the Mallemukfjæld, and *N:os 197* and *204* from the Eskimo Naze, contain more than one species of brachiopod.

In boulder *N:o 154* were found: *Rhynchopora Nikitini* Tschern., *Camarophoria* cfr. *Karpinskii* Tschern., *Athyris Royssii* L'Eveillé, *Reticularia lineata* Martin, *Strophalosia* sp. indet. N:o 2, *Productus compressus* Waag., *Pr. cancriniformis* Tschern., and *Pr. timanicus* Stuck. i. e., 8 species out of 18. Specimen *N:o 197* contains 3 species: *Productus boliviensis* D'Orb., *Pr. pseudohorridus* Wiman and *Pr. timanicus* Stuck., while specimen *N:o 204* contains only 2 species, viz., *Rhynchopora Nikitini* Tschern. and *Productus Lovéni* Wiman and an undetermined *Productus* belonging to the *semireticulatus* group. Special attention must be paid to the forms occurring in specimen *N:o 154*, when attempting to distinguish from this region a fauna belonging to a definite epoch of the Carboniferous.

IV. Review of the Upper Carboniferous in other regions as compared with the Carboniferous of North-east Greenland.

The decisive feature of the Carboniferous deposits is the form of development to which the strata in question can be referred: marine or terrestrial. During the Carboniferous period, continental conditions have existed over extensive tracts, during the prevalence of which the economically important productive coal formations were deposited. Other tracts were covered by sea in which were laid down marine formations — in north-western Europe, where these formations were first studied, the so-called Mountain limestone. During this period, too, there occurred somewhat considerable changes in the distribution of land and sea on the surface of the globe, the extension of the sea, especially during the latter part of the Carboniferous period, being considerably increased, under great transgressions. Just this alternation of marine and terrestrial deposits is of specially great importance for the classification of the Carboniferous formations, and for a comparison of their strata from various districts.

In the following pages we shall employ a division of the Carboniferous system into two groups: the Lower and the Upper Carboniferous. This is in agreement with the plan adopted, for example, by Kayser (Lehrbuch der Geologie II, 4:th Ed. 1911) and Frech (Lethæa Geognostica), but not with that triple division of the system into Lower, Middle and Upper Carboniferous which, in general, is employed by Russian geologists.

In North-Western Europe, the Lower Carboniferous deposits are, as a rule, of marine origin, and are represented both in England and in the north of France and in Belgium by Mountain limestone, which is also found in some few places in Germany. The Upper Carboniferous beds, on the other hand, have been developed in terrestrial facies, with coal beds.

In Russia, the Carboniferous is of immense extent, and occurs in three large districts; a western — to which belongs the so-called Moscow-basin — an eastern and northern, along the western slopes of the Ural mountains and on the shores of the Arctic Ocean in the Timan tundra, and a southern, which includes the coal-fields of Donetz. In Russia, the series of strata chiefly consists of marine deposits among which *Fusulina* limestones are specially prominent, and the formations of terrestrial facies which are found here, occur chiefly in the Lower Carboniferous and in the lowest part of the Upper Carboniferous. The marine formations of the Lower Carboniferous have as a zone fossil, among others, *Productus giganteus.*

The marine Upper Carboniferous group has, in its lower part, beds with *Spirifer mosquensis*, which are found specially well developed in the limestone-quarries at Miatschkowa, near Moscow. *Fusulina cylindrica,* too, occurs here.

The middle part of the Russian Upper Carboniferous is called the *Omphalotrochus*-horizon, and is sometimes divided into two subdivisions: a lower distinguished by *Spirifer Marcoui* Waag., and an upper, with *Omphalotrochus Whitneyi* Meek. This upper part embraces the beds distinguished by Nikitin as the Gshel stage, while other geologists term it the beds with *Spirifer supramosquensis.*

In the upper part of the Upper Carboniferous, we have, lowest down, the horizon with *Productus Cora,* the *Cora horizon*, and, above, the *Schwagerina-horizon* — the uppermost level in the Carboniferous of Russia, and which, especially in the Volga district and in northern Russia, is of great extent and contains a rich brachiopod fauna.

Then comes the Arta stage, which belongs to the Permo-Carboniferous, and, above this, the Permian.

In the eastern Alps (the Carnian and Carinthian Alps) there also occur marine Upper Carboniferous deposits with a rich brachiopod fauna, which, in the main, corresponds to the Cora horizon of Russia, and, to some slight degree, to the Schwagerina horizon. From the principal locality, these formations are termed the Auernigg beds. They are covered by *Fusulina* limestone belonging to the oldest Permian deposits, the so-called Trogkofel beds.

In Asia, marine Upper Carboniferous and Permian strata are discovered in many places, in Asia Minor, the East Indies, Timor, Indo-China, Junnan, and in many places in China and Central Asia. Special mention should here be made of the *Productus* limestone in the Salt Range of India (the northern Punjab) for its rich fauna, which has, too, some forms in common with our North-east Greenland Carboniferous deposits. From Waagen's great monograph we have a fairly close acquaintance with the fauna of the *Productus*

limestone, but, as regards its geological age there exists a difference of opinion to which a brief reference must be made. WAAGEN divides this formation into three divisions; — the lower, the middle and the upper Productus limestone, and was originally inclined to consider the entire series as Carboniferous, but later on, was led to include only the lower beds in that group, and referred the upper deposits to the Permian. NÖTLING and FRECH refer the whole of the Productus limestone to the Permian, and compare it with the Zechstein of Germany. To this, again, lively opposition was raised by Russian geologists, TSCHERNYSCHEW especially, who compares the lower Productus limestone with the Omphalotrochus horizon (*Spirifer Marcoui* occurring in both these formations), the middle with the Cora and the Schwagerina horizons, and the upper with the Arta stage. In general, however, the Productus limestone is, nowadays, regarded as Permo-Carboniferous (the lower beds), and Permian (the middle and upper Productus limestone), the Carboniferous forms in its brachiopod fauna being explained by the theory that, in the main, the brachiopods suffered but unimportant alterations during the course of time. As an argument for a younger age for those formations which, consequently, it is wished to consider as purely Permian, the occurrence is pointed out of peculiar, new elements in the brachiopod fauna (*Richthofenia*, *Lyttonia*, etc.).

It is probably unnecessary to give any detailed account of the marine Carboniferous deposits in North and South America, but such an examination is all the more necessary, on the other hand, as regards those of the Arctic regions. Nearest to the most northern parts of the great Russian Carboniferous district in the Urals and Timan, we have the Carboniferous of Nova Zembla, partly the Upper Carboniferous marine formations, which have been known a long time, and, partly, newer discoveries (LEE, 1909) of Lower Carboniferous Mountain limestone, with *Productus giganteus*, which, consequently, shows that, in this part of the Arctic district, the Carboniferous transgression had already begun during the later part of the Lower Carboniferous period. We ought to pay special attention to the fact that this Lower Carboniferous fauna here occurs in a bituminous limestone.

Further in the north we have marine Carboniferous deposits in Beeren Eiland, and Spitzbergen, and here we encounter the formations that possess the closest analogy to those of North-east Greenland, both from a palæontological and a petrological point of view. Thanks to works published of late years by JOH. GUNNAR ANDERSSON, NATHORST, HOLTEDAHL and WIMAN, our knowledge of the Carboniferous deposits of Spitzbergen and Beeren Eiland

has become fairly thorough, and, more especially, WIMAN's monograph has given us a detailed account of their brachiopod fauna.

The classification of the Carboniferous of Beren Eiland made by JOH. GUNNAR ANDERSSON (1901, Tab. 1) is that shown by the following Table, although the reader should first be reminded that here ANDERSSON — like WIMAN, too, in his summary-table, p. 10 — employs the triple division of the Carboniferous system employed by Russian geologists

C. *Spirifer* limestone	Upper Carboniferous strata.
Unconformity.	
B_2. *Cora* limestone	
B_1. Coral limestone	
Unconformity.	
A_3. *Fusulina* limestone	Middle Carboniferous strata.
A_2. Sandstone (non-fossiliferous)	
A_1. *Ambigua* limestone	
Unconformity.	

To this classification NATHORST (1910, p. 284) adds the remark that: "die Abwechselung der Sedimente, das Vorkommen von Sandsteinsbänken im Spiriferen Kalk, u. s. w. auf noch mehr Veränderungen des Meeresniveaus deuten (?), als aus dem obigen Schema allein hervorgeht".

It is just these great changes in the strata that appear to me to be worthy of our attention when making a comparison between the Carboniferous of North-east Greenland and other similar deposits in the Arctic regions.

The oldest limestone deposit, the *ambigua* limestone, is a red and white mottled limestone possessing definite petrographical analogies in the Lower marine group in our collections from North-east Greenland. Of brachiopods, the ambigua limestone contains (after WIMAN's revision), *Athyris ambigua* SOW., *Eumetria serpentina* DE KON., *Spirifer supramosquensis* NIK., and *Spirifer cameratus* MORTON. Both ANDERSSON and WIMAN compare the Ambigua limestone with the mosquensis level, a connection, the correctness of which appears to me somewhat doubtful; *Spirifer supramosquensis* belongs, in any case, to a higher level than *Sp. mosquensis* (see for example, FRECH. Lethæa, p. 301), and *Sp. cameratus* is a typical Upper Carboniferous species. The *Fusulina* limestone is a bituminous limestone both on Beeren Eiland and on Spitzbergen, even if, in the former locality it has no claim to the denomination "sapropelite". Later investigations have proved that the *Fusulina* occurring in Beeren Eiland is not the Russian *Fusulina cylindrica*, but a species, belonging to the subgenus *Schellwienia*. Consequently, the Fusulina limestone of the

locality in question is now considered as belonging to the lower part of the Upper Carboniferous system.

We have nothing special to remark concerning the next members of the sequence — the Cora limestone and the *Spirifer* limestone — in the Beeren Eiland Carboniferous series, other than the decided unconformity existing between these two deposits.

The oldest part of the marine Carboniferous of Spitzbergen is embraced under the denomination "*Cyathophyllum* limestone"; it covers, unconformably, the Kulm or Devonian, and, in some places, a basal conglomerate has been observed. In the Cyathophyllum limestone, immediately above this conglomerate, HOLTEDAHL has obtained in King's Bay a fauna belonging to the mosquensis zone; otherwise no fossils have been observed in the lower part of this deposit. Within the Cyathophyllum limestone, an ancient division has been made of a Fusulina level and, beneath this, the Cora limestone. WIMAN, in his discussion of the brachiopod fauna, has neglected these divisions, and has placed the species occurring in the Cyatophyllum limestone under one head in his list. As regards the Fusulina limestone, HOLTEDAHL (1912, p. 38) has made observations that tend to show that the Fusulina limestone lies at various levels in various places, although he sees no reason to doubt (p. 36) that the Fusulina limestone investigated by him really represents a stratigraphical zone, belonging to a certain epoch. WIMAN draws the conclusion that, in these enormous sections, more than one Fusulina zone can be encountered, at such places where, for one reason or another, a foraminiferal facies has been developed. The Fusulina limestone proper here in Spitzbergen is highly bituminous, and has received the denomination from STAFF and WEDEKIND of "Foraminiferal sapropelite", but *Fusulinae* occur also in the ordinary Cyathophyllum limestone, so that the *Fusulina*-bearing zone is evidently of greater thickness than that of the Fusulina limestone proper.

The Cyathophyllum limestone of Spitzbergen is of considerable thickness; WIMAN and B. HÖGBOM have, at Cape Anser in Klas Billen Bay, measured a section of about 460 metres (NATHORST, 1910, p. 347, and WIMAN, 1914, p. 11), and HOLTEDAHL (1912, p. 41) gives from King's Bay for Kjærs Berg 400—450 metres, and for Scheteligs Berg 450—500 metres.

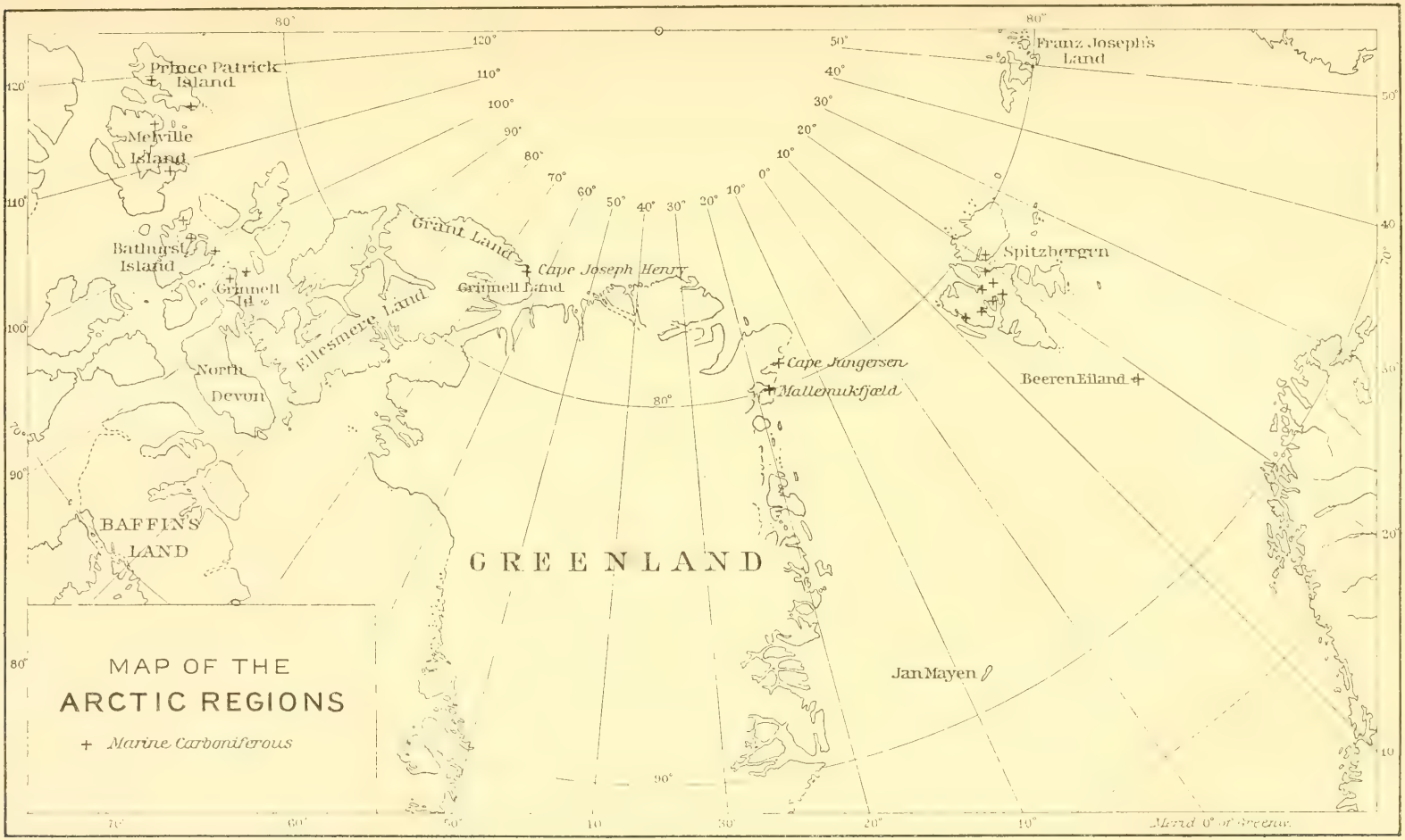
Petrologically, certain divisions of the Cyathophyllum limestone present fairly great agreement with certain parts of the strata of North-east Greenland, especially as regards the almost dense or very fine-grained limestones (W. of and in Koch's section), which are usually of a light grayish-red tinge — with the dense, light limestones with stylolithes, and with the bituminous shales. This rock.

as far as the matrix is concerned, has a great resemblance to the Fusulina limestone of Spitzbergen, but, among the smaller fossil remains, contains fairly numerous fragments of echinoderms, mostly crinoid stem-joints, but only some few *Fusulinæ*. As regards the conclusions reached by Staff and Wedekind (1909, pp. 84—86), I merely wish to point out that, in general, they ascribe to the *Fusulinæ* "ein benthonisches Flachseeleben" and that they suppose the Fusulina limestone to have been deposited in shallow sea-bays, or lagoons, with comparatively quiet waters, having little connection with the open sea, and possessing a maximum depth of about 60—80 metres.

The Cyathophyllum limestone is covered by the exceedingly fossiliferous *Spirifer* limestone, which is specially distinguished by its brachiopod fauna, which Wiman (1914, p. 88), compares with the Schwagerina horizon of Russia. The strata referred to the Spirifer limestone are far from possessing the thickness of the Cyathophyllum limestone. The Spirifer limestone proper is about 10 metres thick, and Wiman reckons together with this 20 to 30 metres of other rocks; on Beeren Eiland, Andersson estimates the thickness of the Spirifer limestone at 71 metres. According to Wiman, the Spirifer limestone is a shallow water, or litoral formation (litoral = that space within which the surf exercises its influence), and almost always contains grains of sand and, sometimes beds of conglomerate in which brachiopod shells are included as pebbles. In the same way, the brachiopod shells are often more or less rolled.

It is not possible to make any definite, close comparison between the Spirifer limestone and the rocks in the Carboniferous formations of North-east Greenland, even if there exists a fairly great exterior resemblance between certain of the specimens found free-lying at the Mallemukfjæld and at Eskimo Naze. That rock especially which occurs at Lovén's Mountain (Spitzbergen) is represented among the boulders collected at the localities mentioned.

In Spitzbergen, the youngest part of the formations referred to the Carboniferous system, or, more definitely, the Permo-Carboniferous, are the siliceous rocks containing *Productus*. These are correlated to the Russian Arta stage, and represent a very considerable thickness; Holtedahl (1912, p. 41) gives very varying figures, from a minimum of 170 metres up to about 500 metres. It is impossible to decide with certainty whether this horizon is represented in North-east Greenland. Among the loose boulders found at the Mallemukfjæld and at Eskimo Naze, some few were discovered that, petrologically, agreed fairly well with the *Productus*-bearing, flint-like rocks of Spitzbergen, but they contained so few fossils that a comparison could lead to no result. This seems to be a reason to refer


MAP OF THE
ARCTIC REGIONS
+ Marine Carboniferous
Prince Patrick Island
Melville Island
Bathurst Island
Grinnell Ld.
North Devon
Ellesmere Land
Grant Land
Cape Joseph Henry
Grinnell Land
BAFFINS LAND
GREENLAND
Cape Jungersen
Mallemukfjæld
Franz Josephs Land
Spitzbergen
Beeren Eiland
Jan Mayen
Mand 0° af Greenw.

the reader to the discussion of the character of the brachiopod fauna (pp. 608–609), where the possibility has been dealt with of a Permo-Carboniferous or a Permian age for some portion of our Carboniferous formations in North-east Greenland. It was argued that the brachiopod fauna could scarcely give any great support to such a possibility, even if the theory could not be entirely neglected.

In the comparison with the Carboniferous formations of the Spitzbergen archipelago, there is another locality to be taken into consideration, viz., Kung Karl's Land (King Charles' Land). The Nathorst Expedition found in 1908 in Kung Karl's Ö (King Charles' Island) at Andrées Bay, a number of boulders of Carboniferous limestone, resembling those existing at Lovén's Berg, and other places in Hinlopen Strait (Nathorst, 1901, p. 372). In these boulders there were found a number of fossils, of which Tschernyschew determined some species, but which say little about the level, however. Among these boulders, which I have had the opportunity of studying at the palæontological Department of the State Museum in Stockholm, there were several different types of rocks represented, and I wish to direct special attention to a fragment perfectly in agreement with the white, and apparently crystalline, but, in reality, conglomeratic limestone, belonging to the collection treated of in this paper, and which was found in situ in the Cape Jungersen section, and in free-lying boulders from the Eskimo Naze and Sophus Müller's Naze.

Arctic North America makes us acquainted with marine Carboniferous at several places. First we must mention the finds on Grant or Grinnell Land, just in the tract that lies nearest to northern Greenland, being separated from Greenland by (Smith Sound, Kennedy Channel and) Robbeson Channel. The localities here are situated on the easternmost point of Grant Land, partly on the Feilding Peninsula with Cape Joseph Henry, and Parry Peninsula with Cape Hecla, the localities lying between 82°30′—82°55′ N. Lat. and about 65° W. from Greenwich, from which places Nares' Expedition brought home collections, and, partly, at Cape Sheridan 82°27′ N. Lat. and 61°30′ W. from Greenwich, from which the Peary Expedition brought home fossils. The fossils from the former locality have been described by R. Etheridge, and the geological conditions by Feilden and De Rance; the fossils from the latter locality have been dealt with by Whitfield. The distance between the two localities is no more than about 30—36 miles, so that they can suitably be mentioned in the same connection.

Next we have to note that marine Carboniferous has been discovered more to the west on the islands west of Baffin's Bay by

M'CLINTOCK[1] on his travels in search of Sir JOHN FRANKLIN. At 76° and 77° N. Lat. he found on Grinnell Island, Bathurst Island, and Prince Patrick Island fossiliferous limestones belonging to the marine Carboniferous. As localities for fossils may specially be named Hillock Point, Melville Island (76° N. Lat. and 111°45′ W. Long.) and Cape Lady Franklin, Bathurst Island (76°40′ N. Lat. and 99° W. Long.),

The location of these islands as well as of the main localities for marine Carboniferous in the arctic regions, mentioned in this paper, is shown in the map p. 598.

HAUGHTON[1], in his investigation of the fossils collected by M'CLINTOCK, has described and figured two species of Carboniferous Brachiopoda; *Productus sulcatus* SOW., var. *borealis* HAUGHTON, a form that partly may be identified with *Prod. timanicus* STUCK., as we shall endeavour to prove below, and *Spirifer arcticus* HAUGHTON.

Respecting these fossils and the figures of HAUGHTON's, TSCHERNYSCHEW (1902, p. 692) has expressed the opinion that he considers the *Spirifer arcticus* HAUGHTON to belong to the subgenus *Spiriferella* and probably to be identical with *Sp. saranæ* VERN.; on the figurings of *Prod. sulcatus* SOW., var. *borealis* HAUGHTON he makes the following remark: "— — —, so scheinen sie mir nicht weniger als zwei verschiedenen Species zu entsprechen: Fig. 1 giebt offenbar eine unserem uralischen *Pr. uralicus* nahe stehenden Form wieder, während Fig. 7 recht lebhaft an die grossen Representanten von *Pr. timanicus* STUCK. erinnert".

Another locality of marine Carboniferous in the archipelago of Arctic North America is represented by Exmouth Island, N. of Grinnell Island (77°15′ N. Lat. and 95°30′ W. Long.) where Sir EDWARD BELCHER found marine fossils that were investigated and figured by SALTER. The fauna contained 3 species of Brachiopoda, that were determined as: *Spirifer Keilhavii* v. BUCH, *Productus Cora* d'ORB. and *Prod. semireticulatus* MART., var. *frigidus* SALT. Respecting this fossil fauna and its stratigraphical importance the reader is referred to TSCHERNYSCHEW (1902, p. 690—692), where, too, a closer interpretation of the fossils is presented.

The marine Carboniferous of the Arctic North America TSCHERNYSCHEW (1902, p. 695) generally ascribes to the Upper Carboniferous; after having emphasized the palæontological correspondence between the Arctic North American deposits with those of the Urals and the

[1] Reminiscences of Arctic Ice-Travel in Search of Sir John Franklin and his Companions. By Captain F. L. M'CLINTOCK. With Geological Notes and Illustrations. By SAMUEL HAUGHTON. Journ. Royal Dublin Soc. Vol. I, p. 183—250. Pls. V—X and Map. Dublin 1856—57.

Timan, he suggests it as possible that the great transgression of the Upper Carboniferous has taken place from Spitzbergen round Greenland to the Arctic North America.

In his description of the Grant Land fauna, ETHERIDGE has determined and in part, given a detailed account of 12 species of brachiopods, belonging to 5 genera, and also of a number of other fossils, bryozoa; and corals, etc. The age of the fauna he gives as "the Carboniferous limestone" (i. e., most probably the Lower Carboniferous Mountain limestone). It is perhaps unnecessary to deal with ETHERIDGE's determination of the brachiopoda, but, on the other hand, I shall give extracts from three expressions of opinion in this regard which very much question the reliability of his conclusions. FRECH (Lethæa, p. 401) mentions that ETHERIDGE describes "die ganze in 83° n. Br. gefundene Fauna als aus dem "Carboniferous limestone" stammend. Jedoch muss die grosse Häufigkeit der Bryozoen und die häufige Beziehung auf die Arbeiten TOULA's über Spitzbergen Bedenken an der Richtigkeit dieser Anschauung erwecken.

Von Productiden werden nur solche Arten beschrieben (l. c. p. 629), welche im Obercarbon vorkommen oder durch ähnliche Mutationen vertreten werden, während typisch untercarbonische Gestalten wie *Prod. giganteus* und *latissimus* fehlen. Besonders wichtig ist auch die Angabe von *Prod. Weyprechti* TOULA (einer Form des obersten Karbon) bei Cap Joseph Henry. Immerhin kann nur eine Revision volle Klarheit über die Horizontierung dieses 'Carboniferous Limestone' bringen".

TSCHERNYSCHEW (1902, pp. 693—695) expresses himself to the same effect and reproduces the fossil-list of brachiopoda and bryozoa, and declares that this "Fossilienverzeichniss bietet ein Gemisch solcher Formen dar, die sich absolut nirgends zusammen vorfinden". He supposes that a want of sufficient material for comparison has been the reason for these determinations, and that a thorough revision would result in other species being determined, "die den in Rede stehenden Kalken ein jüngeres Alter zuschreiben, und zwar das obercarbonische".

When WHITFIELD obtained for examination a collection of Carboniferous brachiopods that the PEARY Expedition (1905—06) brought home from Cape Sheridan, his determinations led to the result that these species were "eminently an expression of an American Coal Measure fauna, according to identifications of the species as usually recognized in this country". On examining the older literature, he, too, objects to ETHERIDGE's determinations, and compares them with his own opinions respecting the separate species and says, in this connection: "this I do because I cannot agree precisely with Mr.

ETHERIDGE's interpretations of their relationship with European species".

WHITFIELD's revision of ETHERIDGE's determinations leads him to the result that in the greater number of the cases, where he considers his specimens are in agreement with a name given by ETHERIDGE, he has been able to identify the specimen in question with an Upper Carboniferous species, or as showing a certain relationship with one. As regards age the Coal Measures of North America are, of course, Upper Carboniferous.

Of the little fauna at his disposal he gives illustrations of a couple of species, and some of these plates afford us an opportunity of drawing comparisons with forms from the Carboniferous fauna of North-east Greenland and of Spitzbergen. A species of *Productus* is referred to *Pr. semireticulatus*, with the following reservation (l. c. p. 55): "If it is to be referred to it at all I would suggest it to be coupled with the term *arctica* as *Productus semireticulatus arctica*". This form is pictured on Pl. 2 as Figs. 8, 9, 10, and a careful examination of these figures places it beyond all doubt that it is the same as the one from Spitzbergen that WIMAN determined as *Prod. inflatus* M'CHESN., and which is also found in the Carboniferous deposits of North-east Greenland, In the group of fossils reproduced in Pl. 1, all the *Productus* shells, with the exception of the uppermost (marked 1), belong to *Pr. inflatus* M'CHESN., viz., 4 more or less complete ventral valves, and a fragment of a dorsal valve, at the bottom to the left of the plate.

The commonest *Productus* species in the Carboniferous deposits, both of Spitzbergen and of North-east Greenland, is *Pr. timanicus* STUCK., and this species is probably also represented among the fossils from Cape Sheridan, for, of the specimens figured by WHITFIELD, I am inclined to refer 4 to this species.

Of these four, 2 are figures of older individuals that have attained larger dimensions than any of my specimens, and are little inferior in size to those given by WIMAN, with which I wish to compare WHITFIELD's specimens, viz., Pl. 1, with the specimen marked 1 in the upper part of the photograph, and Pl. 2, Fig. 11. The former shows a ventral valve, which I should like to compare proximately with WIMAN's Pl. 17, Fig. 20, while Fig. 11, Pl. 2 I should like to compare (in spite of the fact that WHITFIELD's figure shows few details) with WIMAN's Pl. 17, Fig. 21; it (WHITFIELD's) is a dorsal valve seen posteriorly, and the figure shows both the evident mesial elevation corresponding to the sinus, and the flattening of the valve towards the corners, indicating the wings, and the spines at the hinge-line.

Whitfield refers these two figures to *Productus sulcatus* Sow., var. *borealis* Haughton (1857 p. 242, Pl. 7, Figs. 1, 2, 3, 4, 6, 7), but compares them only with Figs. 1 and 7, which picture full-grown specimens, and prefers to call them *Prod. borealis* Haughton, as Davidson gives *Pr. sulcatus* Sow., as synonymous with *Prod. costatus* Sow. It is easy to agree with Withfield that these two figures of Haughton's cannot rightly be referred to *Prod. sulcatus* Sow., but, on the other hand, it would probably be difficult to identify them with absolute certainty. Still one can venture to advance the possibility that the original of the figures has been *Productus timanicus* Stuck., especially since Whitfield identified his fossil with Haughton's species. The characteristics which are specially applicable to *Pr. timanicus* are the deep sinus, which begins at the outermost point of the umbo, and the form of the dorsal valve. Of the remainder of Haughton's figures, 2 and 3 may very well represent younger specimens of *Pr. timanicus*, while Figure 4 presents certain differences, which make its identity with this species less probable. Haughton's diagnosis includes among other things the striking characteristic: "sinu lato, alto, usque in umbonem producto", but on the other hand, "margine cardinali non extenso", does not accord with Fig. 7, which pictures the most full-grown specimen, although, it is true, it is somewhat damaged along the cardinal margin, but has large wings, which give the cardinal margin the greatest breadth of the valve. Whitfield's figures do not indicate such full-grown specimens as this figure of Haughton's, or as the figures quoted from Wiman, Pl. 17, Figs. 20, 21.

Whitfield considers his *Productus borealis* Haughton to be the same as that identified by Etheridge as *Prod. Weyprechti* Toula and if a careful examination be made of what Etheridge (l. c. p. 631) states about *Productus Weyprechti* Toula, especially his hesitation whether he should refer the form in question to *Pr. Weyprechti* or to *Pr. horridus*, we cannot avoid entertaining the thought that it was just *Pr. timanicus* Stuck. that Etheridge had before him.

The two younger specimens that I consider should probably be referred to *Pr. timanicus* Stuck. are pictured by Whitfield on Pl. 2, Fig. 6 and 7, and are given under the name *Pr. Verneuilianus* De Koninck (Recherches sur les Animaux Foss., *Productus* and *Chonetes* p. 163, Pl. 18, Fig. 6, teste Whitfield). I have not succeeded in obtaining the work of De Koninck's quoted, but from what Whitfield says in the text, "with the name appended as a suggestion, and future collections may, or may not, confirm the reference", his hesitation may be seen. Whitfield's figures I hardly hesitate to identify with younger specimens of *Pr. timanicus*. They show spe-

cimens 19—22 mm. in width, and can here be compared with our figures, Pl. XXIX, Fig. 11—13, and STUCKENBERG's figures, 1875, Pl. I, Figs. 5, 6, 7.

In this review we have brought forward reasons in support of the theory a) that *Productus timanicus* STUCK., which occurs in the Upper Carboniferous formations of Arctic North America, and which, in Spitzbergen, is an exceedingly common species, and which is also found in great numbers in the TIMAN tundra of northern Russia, is probably a representative species, as is *Pr. inflatus* M. CHESN., and b) that thereby we have proved for the fauna of our formations in North-east Greenland analogies with homotaxial formations in the Arctic regions both to the east and the west. Still, the agreement between the brachiopod fauna of the Upper Carboniferous deposits of North-east Greenland and the corresponding faunas in Russia, on Spitzbergen and Beeren Eiland is — as will be developed in our next section — a very close one, and, in respect to the number of species in North-east Greenland, very complete, while in consequence of our scanty knowledge of the formations in the regions last mentioned, the connection with the Upper Carboniferous of Arctic North America can hardly be said to be more than indications.

V. Discussion of the testimony borne by the Brachiopod Fauna regarding the relations of the Carboniferous of North-east Greenland to other Carboniferous formations.

It is very difficult to estimate the value of a brachiopod as an indicator of the more minute divisions of the Carboniferous and Permian deposits, partly in consequence of the widely diverging principles applied by palæontologists in their descriptions of fauna (the reader need but be reminded of the difference in the determination of the species existing between DAVIDSON and WAAGEN), but also, in some degree, as a result of the varying opinions held with regard to some of the formations now in question; we need only mention, for example, the *Productus* limestone of Salt Range, India.

But the determination of the age of a formation by means of the brachiopod fauna is impeded to a considerable degree, by, above all, the extensive vertical distribution of various elements of the fauna, so that, in some cases, a purely quantitative statistic method is not the correct one to be employed, but it becomes necessary to attach a certain importance to the occurrence or absence of certain fauna-elements or to their first appearance or their extinction for the determination of the geological stage.

The vertical extension of the Brachiopod Fauna.

The 21 forms occurring in other localities, which has been specifically determined (or which have been closely compared with some determined species), that have been given in the list on page 607, and are divided into: 8 in the Lower group and 13 in the Upper, can, as far as I am able (with the help of the literature at my disposal) to ascertain their distribution, be placed in 5 different divisions, viz.:

A. Species which begin in the Lower Carboniferous and ascend as far as to the Permo-Carboniferous, or the Permian (stratigraphically worthless);

B. Species which begin in the Lower Carboniferous deposits and ascend into the Upper Carboniferous;

C. Species that have, hitherto, been found only in the Upper Carboniferous;

D. Species that begin in the Upper Carboniferous and ascend into the Permo-Carboniferous and Permian;

E. Species that have, hitherto, only been found in the Permian.

Below we shall now group our forms into these divisions, when a * will stand for the species belonging to the Lower group of the Carboniferous deposits of North-east Greenland, while a † will signify the species belonging to the Upper group. Forms respecting which there may exist some doubt will be placed within parentheses in the division to which we consider the species in question not to belong.

A. † *Athyris Royssii* L'EVEILLÉ.
† *Reticularia lineata* MARTIN.
* *Productus longispinus* SOW.
(† *Spirifer* cfr. *striatus* MARTIN).
(† *Productus inflatus* M'CHESN.). = 3 Sp.

B. † *Spirifer* cfr. *striatus* MARTIN.
* *Productus punctatus* MARTIN.
(* — *simensis* TSCHERN.). = 2 Sp.

C. † *Camarophoria* cfr. *Karpinskii* TSCHERN.
* *Spirifer rectangulus* KUT. var. *alta* n. var.?
* *Martinia corculum* KUT.
* *Productus simensis* TSCHERN.
† — *Wallacianus* DERBY.
† — *Lovéni* WIMAN.
† — *timanicus* STUCKENB.
† — *pseudohorridus* WIMAN. = 8 Sp.

D. Of this division, those species that ascend into the Permo-Carboniferous are marked *PC.* after the author's name, and those that go up into the Permian with a *P.*
† *Rhynchopora Nikitini* TSCHERN. P.
* *Spirifer supramosquensis* NIK. PC.
* — *Fritschi* SCHELLW. P.

Table of the Carboniferous Brachiopoda of North-east Greenland and their vertical range and occurrence in other regions.

		N. E. Greenland Lower Marine	N. E. Greenland Upper Marine	Spitzbergen	Beeren Eiland	Russia: Mosquensis horizon	Russia: Omphalotrochus h.	Russia: Cora h.	Russia: Schwagerina h.	Russia: Arta stage	Russia: Permian	Occurrences in other regions
1	*Rhynchopora Nikitini* TSCHERN.	..	+	+	+	..	+	+	+	+	+	
2	*Camarophoria* cfr. *Karpinskii* TSCHERN.	..	+	..	..	..	..	..	+			
3	*Athyris Royssii* L'EVEILLÉ	..	+	..	+	..	..	?	?	?	?	Middle and Upper Productus Limestone of Salt Range.
4	*Spiriferina Mylii* n. sp.	..	+									
5	*Spirifer* n. sp.? ex aff. *Sp. duplicicostæ* PHILL.	..	+									
6	— cfr. *striatus* MART.	..	+	..	..	+	..	..	+	..	..	Lower Productus limestone of Salt Range.
7	— *supramosquensis* NIK.	+	..	+	+	..	+	+				
8	— *Fritschi* SCHELLW.	+	..	+	..	..	..	..	+	..	..	Carnian Alps.
9	— *fulmari* n. sp.	+										
10	— *rectangulus* KUT., var. *alta* n. var.	+	..	+	..	..	..	..	+			
11	*Martinia corculum* KUT.	+	..	..	..	..	..	..	..	..	..	Carnian Alps.
12	*Reticularia lineata* MART.	..	+	+	+	+	+	+	+	+	..	Lower Productus Limestone of Salt Range. Carnian Alps.
13	*Strophalosia* sp. indet. N:o I	..	+									
14	— - — - II	..	+									
15	*Chonetella nasuta* WAAG.	+	..	..	..	..	..	..	..	..	..	Middle and Upper Productus Limestone of Salt Range.
16	*Productus boliviensis* D'ORB.	..	+	+	+	..	..	+	+	+	..	North and South America. Permian of Indian Archipelago.
17	— *inflatus* M'CHESN.	..	+	+	+	..	+	+	+	+	..	Arctic North America. Mississippian.
18	— *longispinus* SOW.	+	..	+	..	..	?	..	?	..	..	Great Britain, Mountain Limestone.
19	— *compressus* WAAG.	..	+	..	..	..	..	..	..	..	..	Upper Productus Limestone of Salt Range.
20	— *simensis* TSCHERN.	+	..	..	..	..	..	..	+			
21	— *cancriniformis* TSCHERN.	..	+	+	..	..	..	..	+	+	..	Carnian Alps.
22	*Wallacianus* DERBY	..	+	..	..	..	..	..	+	..	..	Brazil.
23	*Lovéni* WIMAN	..	+	+								
24	*punctatus* MART.	+	..	+	..	+	+	+	+			
25	— *pseudohorridus* WIMAN	..	+	+								
26	— *timanicus* STUCK.	..	+	+	+	..	+	+	+	..	..	Arctic North America.

† *Productus inflatus* M'CHESN. PC.
† — *boliviensis* D'ORB. PC.
† — *cancriniformis* TSCHERN. P.
(* *Martinia corculum* KUT.) P.?. = 6 Sp.

E. * *Chonetella nasuta* WAAG.
† *Productus compressus* WAAG. = 2 Sp.

In a tabulated summary the ratios existing between these various divisions of the species can be expressed as follows:

	A	B	C	D	E	Total
Lower group	1	1	3	2	1	8
Upper group	2	1	5	4	1	13
Total...	3	2	8	6	2	21

In this table consequently, the species that are either restricted to the Upper Carboniferous, or, from that level ascend into the Permo-Carboniferous or the Permian, are in a decided majority, as they form $8 + 6 = 14$ species, or $^2/_3$ of the entire number. Another striking fact is, that there is no species here that is restricted to the Lower Carboniferous, so that we must consider the possibility of these formations from North-east Greenland belonging to the Lower Carboniferous deposits, as being entirely excluded. As regards the possibility of a Permo-Carboniferous or a Permian age for these formations or for any part of them, this, in consequence of the fauna-elements, cannot, of course, be denied, especially when we take into consideration that such a large proportion of the collections was made from talus boulders or free-lying fragments. However, the support given by the fauna for a younger age than the Upper Carboniferous is not specially strong. Of the species, Div. D., which, from the Upper Carboniferous deposits ascend into the Permo-Carboniferous and the Permian, there is none that can be considered as a precursor of the Permian fauna, but all of them possess a purely Carboniferous character. Of the two forms that, hitherto, have been found only in Permian deposits, *Productus compressus* WAAG. is a purely Carboniferous type, with closely related forms, in the Upper Carboniferous above all, but also in the Lower Carboniferous deposits, while *Chonetella nasuta* WAAG. is a more isolated type of the family *Productidæ* which has by no means any special younger character, but can very well be derived from older species of *Chonetes*. HALL and CLARKE (Vol. I, p. 313) say speaking of the genus *Chonetella*: "Aside from the broadly curved brachial ridges, its characters are

so strongly chonetoid as to render its separation from *Chonetes* exceedingly difficult". Of the brachiopod genera specially characteristic for the Permian there are no representatives in the Carboniferous deposits of North-east Greenland. Of the whole of the brachiopod fauna occurring here (in North-east Greenland) the two undetermined species of the genus *Strophalosia* are the ones that have most of a Permian character (see for example, WAAGEN, pp. 640—641), this genus having its principal extension in the Permian formation, even if it have precursors in the superior part of the Upper Carboniferous (the *Schwagerina* horizon), and still more so in the Permo-Carboniferous.

A further argument against a younger age is offered when we consider the species of the fauna which have, with certainty, been determined as belonging to the same definite level (see p. 591); the species here, especially in the bituminous limestone from the profiles in Holm's Land (*N:o 190*), and in the light limestone from the Mallemukfjæld, present — as will be further developed later on — no special accumulation of forms that possess a Permian character, but show an assemblage of species which must be said to have an Upper Carboniferous aspect.

For a more detailed classification of the North-east Greenland Carboniferous formations within the Upper Carboniferous beds, we shall be obliged to have recourse to a comparison with the formations with related fauna, which we meet in the, geographically, nearest situated deposits in Beeren Eiland and Spitzbergen, and in Russia, especially in the Urals and the Timan tundra. Of the close connection between the Carboniferous deposits of Spitzbergen-Beeren Eiland and those of Russia, especially in the Urals and the Timan, we have good testimony in WIMAN's (1914, pp. 87—88) statement respecting their close connection, and in his comparative tables of the brachiopod fauna in these formations.

The horizontal Distribution of the Brachiopod Fauna.

Of the 21 determined species, the greater number, or 17 species can also be found in the Carboniferous of Russia, or are represented there by very closely related forms. Of the same 21 forms, 14 are found again in Spitzbergen and Beeren Eiland (taken as one locality), and of these 14 forms, 12 (i. e., all but 2) are also to be found in the Carboniferous formations of Russia. The 2 forms that occur neither in Russia nor in Spitzbergen—Beeren Eiland, are species from the *Productus* limestone of the Salt Range (India).

If to this total number of forms that are specifically determined,

we add the three forms determined as n. sp., the two sp. indet. of *Strophalosia*, and leave the undeterminable forms out of the reckoning, it thus proves that the brachiopod fauna of our North-east Greenland Upper Carboniferous deposits are so nearly connected with that of the Russo-Arctic district, that these faunas must have lived in seas possessing free and open communication with each other.

The division of the forms common to the various localities into Lower and Upper groups within the Carboniferous of North-east Greenland, presents approximately the same proportions as the number of the brachiopods that have been found within the respective groups.

The ratio is shown by the following table:

	Number	pCt. of whole number	North-east Greenl.	
			Older Group	Younger Group
Total number of forms	26	—	9	17
Forms known from other localities	21	82	8	13
New species	3	—	1	2
Forms from the Russo-Arctic district	19	73	6	13
— — Spitzbergen-Beeren Eiland	14	54	5	9
— — Russia	17	65	6	11
— — — , wanting in Spitzbergen-Beeren Eiland	5	19	1	4
— — Spitzbergen-Beeren Eiland, wanting in Russia	2	8	—	2
— common to Russia and Spitzbergen-Beeren Eiland	12	46	5	7

If we pay special attention to the vertical distribution of the brachiopods of North-east Greenland within the Carboniferous formations of Russia we find that they occur chiefly within the divisions that have been termed the *Omphalotrochus-*, *Cora-*, and *Schwagerina* horizons. Species that can really be said to point to a lower level, the *mosquensis* horizon especially, are wanting, if we deduct those that persist from the Lower Carboniferous to the Permian, while, though, it is true, species pointing to the Permo-Carboniferous are not absent, still, as we have shown above, they can scarcely entitle us to consider them as determinative of any part of the formations in question as being Permo-Carboniferous or Permian.

We must, therefore express the opinion that the marine Carboniferous measures of North-east Greenland belong to the middle and upper part of the Upper Carboniferous

deposits, or to the divisions which, in Russia, are termed: the *Omphalotrochus* horizon, the *Cora* horizon and the *Schwagerina* horizon.

When we thus give a general determination of the age of these formations, the question presents itself, whether a more exact division of the measures can be carried out based on the age of the brachiopod fauna. Here, of course, we again meet with the difficulty that the greater part of the collections was obtained from free-lying boulders, and that it was but rarely that several species were found together so as to entitle us to say that they lived together. We have given these instances above, and shall now proceed to make a further investigation of the vertical distribution of these species thus occurring here in company.

Of the 8 species belonging to the Lower group, there occur in the bituminous marl-shale 4 together; of these, *Spirifer supramosquensis* is characteristic for the middle Upper Carboniferous beds, but ascends to a higher level, while, of the other species, *Productus simensis* and *Spirifer rectangulus* are found in the *Schwagerina* limestone, and *Chonetella nasuta* is described from the *Productus* limestone in the Salt Range. An attempt to compare this special assemblage of fossils with the *Omphalotrochus* horizon, can, consequently, hardly be called satisfactory.

Considerably better, however, will be the result of an examination of those fossils from the Upper group that occur together. In the limestone boulder, *N:o 154*, from the Mallemukfjæld, there occur 8 species of the 17 belonging to the group: In addition to the ubiquitous *Athyris Royssii* and *Reticularia lineata*, there are also discovered here the Upper Carboniferous *Camarophoria* cfr. *Karpinskii*, and, of species that ascend from the measures just mentioned to the Permo-Carboniferous, *Rhynchopora Nikitini*, *Productus cancriniformis* and *timanicus*, and *Pr. compressus* from the *Productus* limestone of the Salt Range, and last *Strophalosia* sp. indet. *N:o 2*. This association of species contains, it is true, relatively many forms that ascend into the younger Permo-Carboniferous deposits and into the Permian, but a careful examination shows, however, that it is just in the *Schwagerina* horizon that such an assemblage is found. Another, quite similar, but considerably poorer, embracing no more than 3 species, occurs in the boulder *N:o 197* from the Eskimo Naze, where *Productus boliviensis* and *timanicus*, which, from the Upper Carboniferous measures ascend into the Permo-Carboniferous, occur together with *Pr. pseudohorridus* from the Spitzbergen *Spirifer* limestone and *Productus* flint. These fossils point very decidedly to the *Schwagerina* horizon, and from them it would be difficult to discover any

cogent reason for ascribing to these small faunas a younger age, this deduction being quite in agreement with what I have stated above respecting the associated existence of the fauna as a whole.

We can, consequently, state with certainty that, according to the testimony of the brachiopod fauna, there exist in the Upper group of the Carboniferous deposits of North-east Greenland, formations equivalent to the *Schwagerina* horizon of Russia, while, in addition, *Schwagerina princeps* itself occurs in many localities in these North-east Greenland Measures.

The comparison with the brachiopod fauna of the Upper Carboniferous measures of Spitzbergen can also be said to lead to the result that, especially, the Upper group of the North-east Greenland marine Carboniferous contains a brachiopod fauna bearing a great analogy to that of the *Spirifer* limestone.

VI. Conclusions.

1) North-east Greenland possesses a series of marine Upper Carboniferous deposits which, as in Spitzbergen, transgrediate over Lower Carboniferous measures of terrestrial development undetermined as to stratigraphical level.

2) This transgression has occurred gradually, so that repeated oscillations of level have taken place in the lower part of the series of strata; the upper part of the series has a more constant marine aspect, but this part too, in some degree at least, has been deposited in very shallow water or even in the littoral zone, as is shown by certain peculiar rock-species, which are conglomerates in miniature.

3) The Brachiopod Fauna occurring here points to the middle and upper part of the Upper Carboniferous series, the OMPHALOTROCHUS-, CORA-, and SCHWAGERINA horizons in the Upper Carboniferous measures of Russia; the possibility of the sequence of strata ascending higher up to the Permo-Carboniferous is not altogether excluded, even

if the composition of the Brachiopod Fauna makes such an assumption hardly probable.

4) The Brachiopod Fauna has a decided Russo-Palœarctic character, but presents, however, some points of connection with the (far less perfectly known) Brachiopod Fauna of the Upper Carboniferous deposits of Arctic North America.

5) The North Polar Sea of the Upper Carboniferous period has been in connection from Russia-Spitzbergen, via Northern Greenland, with a sea in Arctic North America.

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All the specimens figured belong to the Mineralogical Museum of Copenhagen.

All the figures are natural size, unless otherwise stated.

The fossils are photographed by Mr. A. HJ. OLSSON and the photographs retouched by Mr. J. V. ENGLUND, both of Stockholm.

PLATE XXVII.

PLATE XXVII.

Camarophoria cfr. *Karpinskii* Tschern. p. 557. — Boulder, Mallemukfjæld. (*N:o 154*).

Fig. 1. Ventral view.

— 2. Anterior view.

Spiriferina Mylii n. sp. p. 560. — Boulder, Sophus Müller's Naze (*N:o 209*).

— 3. Ventral view of the holotype.

— 4. Dorsal — - - —

— 5. Lateral — - - —

— 6. Posterior — - - —

— 7. Shell surface of the ventral valve, enlarged ca. 5 diam.

Spirifer l. *Spiriferella* sp. indet. p. 562. — Boulder, the mainland behind Henrik Kröyer's Islets (*N:o 214*).

— 8. Ventral view.

Spirifer l. *Spiriferella* sp. indet. p. 562. — Boulder, the mainland behind Henrik Kröyer's Islets (*N:o 214*).

— 9. Posterior view of ventral valve.

Spirifer n. sp.?, ex aff. *Sp. duplicicostæ* Phill. p. 563. — Boulder, Cape Jungersen section (*N:o 111*).

— 10. Ventral view.

— 11. Lateral view.

Spirifer cfr. *striatus* Mart. p. 564. — Boulder, Sophus Müller's Naze (*N:o 179*).

— 12. Ventral view.

— 13. Lateral view.

Spirifer supramosquensis Nik. p. 565. — The Conglomerate section (*N:o 190*).

— 14. Ventral view.

— 15. Lateral view.

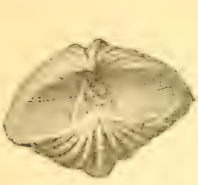
— 16. Interior of the ventral valve, showing the dental plates.

Spirifer fulmari n. sp. p. 569. — Mallemukfjæld (*N:o 166*).

— 17. Ventral view of the holotype.

— 18. Lateral — - - —

— 19. View of the interior of the ventral valve.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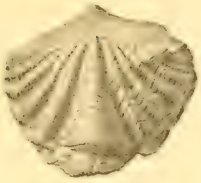
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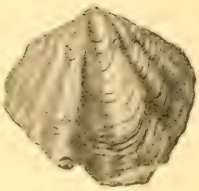
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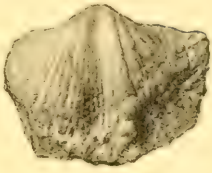
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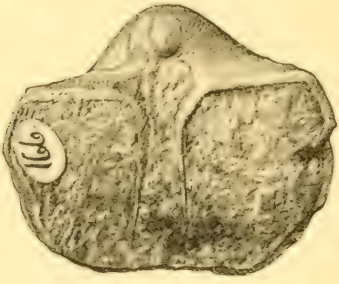
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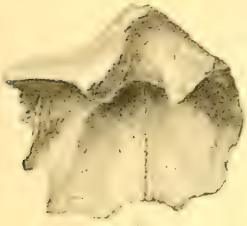
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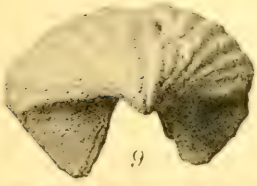
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PLATE XXVIII.

PLATE XXVIII.

Spirifer rectangulus Kut., var. *alta* n. var.?, p. 571. — The Conglomerate section (*N:o 190*).

Fig. 1. Specimen I. Ventral view.
— 2. — Posterior view.
— 3. — Lateral view.
— 4. — Shell sculpture enlarged ca. 5 diam.
— 5. Specimen II. Ventral view.
— 6. Specimen III. Ventral view.

Strophalosia sp. indet N:o 1. p. 575. — Boulder, Eskimo Naze (*N:o 203*).

— 7. Ventral view.

Strophalosia sp. indet. N:o 2. p. 576. – Boulder, Mallemukfjæld (*N:o 154*).

— 8. Ventral view.
— 9. Ventral valve, seen sideways from behind.

Chonetella nasuta Waag. p. 576. — The Conglomerate section (*N:o 190*).

— 10. Ventral view of complete specimen.
— 11. Dorsal — - — —
— 12. Anterior — - — —
— 13. Lateral — - — —
— 14. Posterior — - — —

Productus compressus Waag. p. 580. — Boulder, Mallemukfjæld (*N:o 154*).

— 15. Ventral view.
— 16. Lateral view of the entire specimen.
— 17. = 16 with the ventral valve and the visceral room removed.
— 18. The dorsal valve and its cast.

Productus cancriniformis Tschern. p. 582. — Boulder, Mallemukfjæld (*N:o 154*).

— 19. Specimen I. Ventral view.
— 20. — Anterior view.
— 21. — Lateral view.
— 22. Specimen II. Lateral view.

Productus Lovéni Wiman, p. 584. — Boulder, Eskimo Naze (*N:o 204*).

— 23. Dorsal valve, seen from the visceral room.

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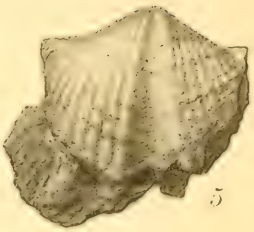

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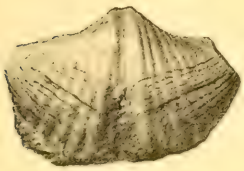

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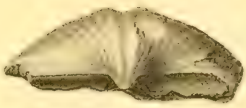

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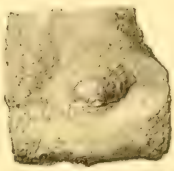

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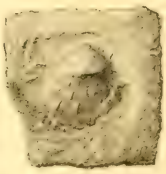

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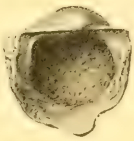

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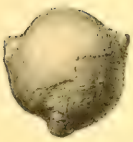

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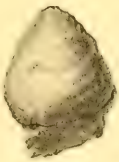

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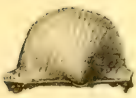

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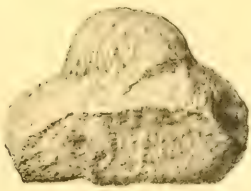

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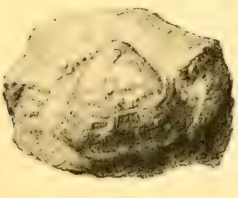

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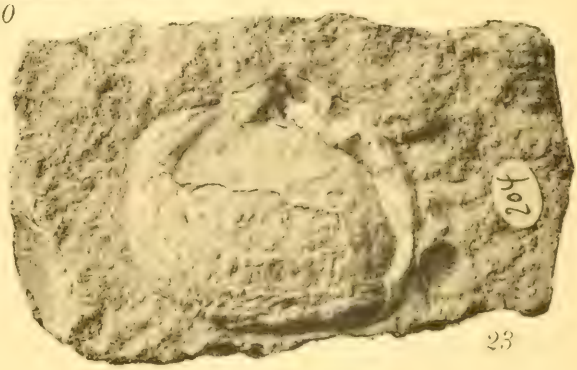

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PLATE XXIX.

PLATE XXIX.

Productus Wallacianus Derby. p. 583. — Boulder, Eskimo Naze (*N:o 213*).

Fig. 1. Specimen I. Ventral view of the ventral valve.
— 2. — Lateral — - - — —
— 3. Specimen II. Cast of dorsal valve.
— 4. — The same, lateral view.

Productus punctatus Martin p. 585. — Amdrup's Land, Western river (*N:o 160*).

— 5. Dorsal valve.

Productus pseudohorridus Wiman p. 586. — Boulder, Eskimo Naze (*N:o 197*).

— 6. Posterior view of entire specimen.
— 7. Anterior — - — —
— 8. Lateral — - — —
— 9. Dorsal — - — —
— 10. Dorsal valve seen from the interior.

Productus timanicus Stuck. p. 586. — Boulder, Mallemukfjæld (*N:o 154*).

Specimen I. A very young individual.

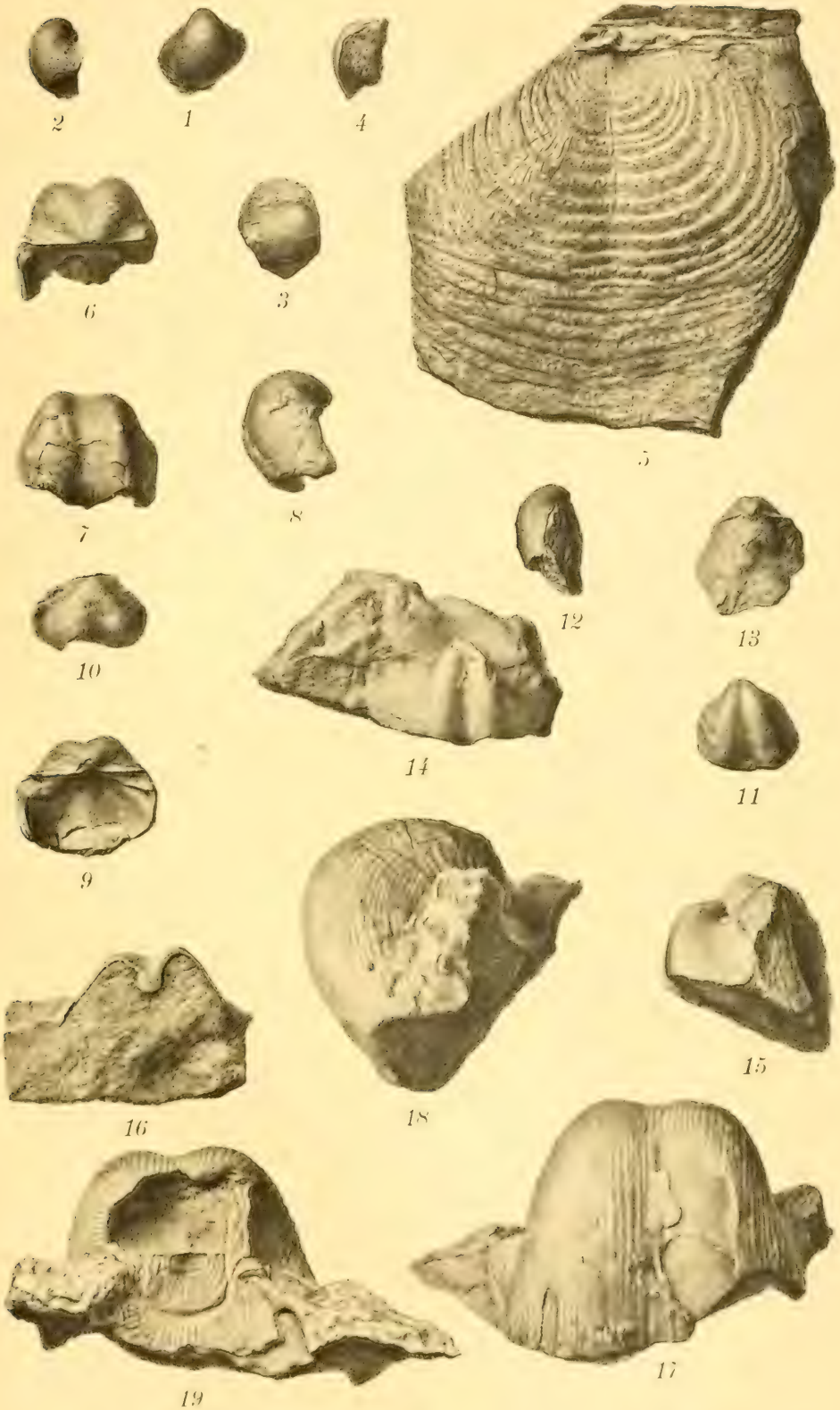
— 11. Ventral view.
— 12. Lateral —
— 13. Showing the beak and the hinge-line.

Specimen II. An older, but yet not adult individual.

— 14. Ventral view.
— 15. Lateral —
— 16. Anterior —

Productus inflatus M'Chesn. p. 578. — The Cape Jungersen Section (*N:o 128*).

— 17. Ventral view.
— 18. Lateral —
— 19. Dorsal —



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GEN. STAB. LIT. ANST.

XXI.

QUATERNARY FOSSILS COLLECTED BY THE DANMARK EXPEDITION

BY

AD. S. JENSEN.

1917.

The material brought home by the Danmark Expedition includes a number of quaternary fossils, for the most part mollusc shells, collected during the course of excursions starting from Danmarks Havn. The samples are on the whole small, and present for the most part the impression of having been gathered together in a casual and unsystematic way. This is evident, partly from the fact that smaller forms are wanting, partly also from the lack of representative samples of the soil with its mollusc content, which afford the only possible means of obtaining a proper view of the fauna concerned.

These shortcomings are, however, — apparently, at least — compensated for by the uniformity of the fauna in all localities, and by the fact that all the forms found are, with a single exception, still living on the north-east coast of Greenland.

The exception referred to is *Pecten islandicus*. This bivalve has not been found living in East Greenland, albeit the present mollusc fauna of that country may now be taken as well known; nor has it been met with in other true high-Arctic seas, such as the Kara Sea, the Polar Sea of Siberia, and the Polar Sea north of arctic America. It lives, however, at Labrador, West Greenland, Jan Mayen, Iceland and Spitzbergen, as also in the Barents Sea. Though it should be considered as a comparatively Arctic form, this species is nevertheless not to be regarded as particularly high-Arctic [1]), and its presence in a raised stratum in North-east Greenland would seem to indicate a rise, although only slight, of temperature, with consequent deterioration of the climate. Such rise of temperature would probably coincide with the postglacial temperature optimum known from other regions, both in West and East Greenland. In the case of East Greenland, this feature is known especially from the finds of *Mytilus edulis*

[1]) cf. Ad. S. Jensen, The Danish Ingolf Expedition, II, 5, Lamellibranchiata. Part I, 1912, p. 18—19.

made by the NATHORST Expedition in raised strata at Sophia Sound and Franz Josephs Fjord[1]); also, moreover, from the specimens of *Pecten islandicus* found by the RYDER Expedition in late-quaternary deposits at Scoresby Sound[2]).

Another point worthy of note is the fact that marine quaternary mollusc shells were met with by the Danmark Expedition up to a height of some 125 metres above sea level, which is far in excess of the greatest altitude noted in hitherto published finds from East Greenland, none of which go up beyond about 50 metres.

The material comprises in all 18 species of determinable molluscs, besides one serpulid, one Balanus species, and 1 echinoderm, apart from Foraminifera and calcareous algæ *(Lithothamnion)*.

The determinable species are as follows:

Lamellibranchiata:

Yoldia (Portlandia) arctica GRAY,
Modiolaria lævigata GRAY,
Pecten islandicus MÜLLER,
Astarte Banksii LEACH,
Astarte borealis CHEMNITZ,
Axinus flexuosus MONTAGU,
Tellina (Macoma) calcaria CHEMNITZ,
Tellina (Macoma) Loveni STEENSTRUP,
Cardium ciliatum FABRICIUS,
Cardium groenlandicum CHEMNITZ,
Mya truncata L.,
Cyrtodaria Kurriana DUNKER,
Saxicava arctica L.,
Thracia septentrionalis JEFFREYS.

Gastropoda:

Natica affinis GMELIN,
Trophon clathratus L.,
Buccinum Belcheri REEVE,
Sipho (Tritonofusus) Kröyeri MÖLLER.

Serpulidæ:

Apomatus globifer THÉEL.

Balanidæ:

Balanus porcatus DA COSTA.

Echinidæ:

Strongylocentrotus dröbachiensis MÜLLER.

[1]) A. G. NATHORST: Bidrag till nordöstra Grönlands geologi. Geol. Fören. Förhandl. Vol. 23, 1901, p. 304.

[2]) AD. S. JENSEN: On the Mollusca of East Greenland, I. Lamellibranchiata. With an introduction on Greenland's fossil mollusc-fauna from the quaternary time. Meddel. om Grønland XXIX, 1909, p. 301—02.

Before proceeding to enumerate the localities where these quaternary fossils were found, — I have for the sake of convenience arranged them in order of latitude from south to north — and to the species, some general observations by HAKON JARNER, Geologist to the Expedition, as to the occurrence of quaternary fossils on the territory traversed by him, may here be quoted. Mr. JARNER states, it should be noted, that the fossils brought home can only be regarded as samples, and do not present any correct view of the actual distribution.

"Quaternary fossils are found throughout the whole of the low moutonné coast region from the Hochstetter Vorland to Jøkelbugten; beyond this area I have no knowledge of the country from personal observation. Here, however, they are present in numerous localities, generally of but slight extent. Up to about 30 metres — or more correctly, perhaps, 20 — above sea level, it is hardly necessary to note "localities" in the plural; the whole area may be taken as one locality of a most varying local character in consequence of the insular landscape presented by this terrain moutonné under its earlier partly submerged state, a landscape which still is to be found outside along the coast. Normally, there is a thin layer of bottom moraine above the rock. Beach formations do not appear as a regular covering layer, but in many places gravel and sand have been washed up into beach lines and terraces of a highly variable, but as a rule inconsiderable extent. These — probably in most cases arisen under disturbed conditions, — do not contain shells. Beside these formations, however, which at the first glance mark the whole tract as formerly submerged, we frequently find, in hollows and depressions, deposits of loose matter. These are rarely of any considerable thickness, but may in places be fairly rich in quaternary fossils. The material is mainly gravel and sand, the fossils principally *Saxicava* and *Mya*; certain spots, where more shelter was available, show clay (with *Yoldia*).

In some few localities, — particularly Hvalsletten — the formation is seen to be on a somewhat larger scale. Here, an abundance of material was available, brought down by the glacier through Sælsøen. The masses were carried by the Salmon River (Lakseelven) down to the northern part of Dove Bay, where they could be quietly deposited on the inner side of Germania Land and the islands. The formation here is still taking place on a larger scale than normally; the whole of "Lumskebugten" is at present in process of silting up, and joining on to Hvalsletten. This, the largest deposit, is also the richest in shells; on some parts of the slope facing down to the Salmon River, they may be "shovelled" up.

In the more distant parts, towards Snenæs, sufficiently quiet

conditions have also prevailed for the deposit of clay in somewhat larger formation than the normal; *Yoldia* shells are here of fairly frequent occurrence. Besides these large continuous tracts of clay, smaller patches are found in several places on Hvalsletten, at times of quite pygmean dimensions, some few metres square. These have been formed in shelter, close to sharply rising ground, as for instance beside the so-called "Bastion".

Altogether an exception, both as regards thickness (some 5 metres) and extent, and also level, is the tract of clay above the jurassic plateau of Koldewey Island. Presumably, the high western portion of the island has here played the same part as the "Bastion" of Hvalsletten on a smaller scale, the quiet water in a sheltered corner behind these rocks offering opportunity for formation of the deposit. Its altitude, about 125 metres above sea level, is likewise unique. True, there are numerous evidences of sea action over the whole investigated region, even up to far greater heights, but quaternary fossils are otherwise only found in the lower parts, and for the most part in the very lowest. The peculiarity may be due to the fact that the fossils were preserved in the clay and thus better able to withstand the effects of weather than shells in the altogether superficial sand formations; other conditions have, however, probably contributed, and I hope in another publication to offer some further observations on this point."

I. Island in Bessels Fjord,

ca. 76° N. lat. ca. 20° W. long.

Raised sea bottom, 0—10 m above sea level. 23. 5. 1908.

Saxicava arctica L.

5 shells, up to 37 mm. Of an elongated *arctica*-form.

II. Great Koldewey Island,

76°10′ N. lat. 18°35′ W. long.

From clay above the Jura-deposits, 120 m above sea level. 3. 6. 1907.

Nucula sp.

Yoldia (Portlandia) arctica GRAY.

3 spec., 15, 15·5 and 16·5 mm. The shells in several places broken off, leaving the stone core more or less exposed; on one of the shells, the finely undulating structure characteristic of the species is still preserved.

Portlandia sp.

1 small spec.

Astarte borealis CHEMNITZ.

1 spec., 11 shells and 2 stone cores, 6·5—40 mm. Some of the pieces appear to differ sligthly from *A. borealis*, as for instance in the prolonged fore-end.

Tellina calcaria CHEMNITZ.

16 shells, ca. 22—30 mm.

Cardium ciliatum FABRICIUS.

Fragments of 15 shells, small and medium sized.

Cardium groenlandicum CHEMNITZ.

Fragments of 6 shells, small and medium sized.

Cyrtodaria Kurriana DUNKER.

1 spec., ligament still preserved, length 28 mm., height 13 mm. Also a fragment of a stone core and of a shell.

Saxicava arctica L.

1 spec., 27 mm and 2 fragments.

Mya truncata L.

Fragments of grown specimens.

III. Depotøen near Cape Peschel,

76°14′ N. lat. 19°56′ W. long.

ca. 2 m above sea level. 28. 5. 1907.

Mya truncata L.

7 shells, 26—50 mm, shape medium-elongated or very short *(uddevallensis)*.

Saxicava arctica L.

3 shells of the *pholadis*-form, 41—46 mm.

IV. Camping ground N.W. of Teufelkap,

76°24′ N. lat. 20°45′ W. long.

23.—25./5. 1907.

1. ca. 10 m above sea level.

Tellina calcaria CHEMNITZ.

1 shell, 33 mm.

Mya truncata L.

17 shells, 27—60 mm, of greatly varying shape; some as *ovata*- and a blunter form of same, others of the truncated form down to the short *uddevallensis*-type.

Saxicava arctica L.

17 shells, 28—49 mm, some of an elongated *arctica*-form, others as *pholadis*-type.

2. ca. 125 m above sea level.

Saxicava arctica L.

Some small fragments.

V. Island due N. of Edwards Island in Dove Bay,
76°37′ N. lat. 21°5′ W. long.

From the Yoldia clay, ca. 5 m above sea level. 19.—20. 5. 1907.

Yoldia (Portlandia) arctica Gray var. *portlandica* Hitch.

4 spec. and abt. 20 shells, 6— ca. 25 mm.

Axinus flexuosus Montagu.

1 spec., 8 mm high.

Mya truncata L.

2 shells, ca. 22—31 mm, and a fragment of a larger one.

Saxicava arctica L.

Ca. 40 shells, 22·5—41 mm. Most are of an elongated *arctica*-form, some few as the *pholadis*-form, on the whole of medium thickness.

VI. The Point at Borgfjord,
76°38′ N. lat. 21°45′ W. long.

20 m above sea level. 21. 5. 1907.

Mya truncata L.

Some fragments.

Saxicava arctica L.

Some fragments.

VII. Renskæret,
76°41′ N. lat. 18°35′ W. long.

Near the top.

Sipho (Tritonofusus) Kröyeri Møller.

1 medium sized spec., fragmentary and much eroded.

VIII. Peninsula east of Cape Bismarck,
ca. 76°42′ N. lat. ca. 18°35′ W. long.

ca. 5 m above sea level. 10. 8. 1907.

Astarte borealis Chemnitz.

5 shells, 22—28 mm.

Mya truncata L.

2 shells, 36—48 mm, cut off in front, and a fragment.

Saxicava arctica L.

20 shells, 23·5—37 mm, mostly of an elongated *arctica*-form, some as *pholadis*, medium thickness, some few extremely thick.

IX. Peninsula east of Cape Bismarck,
ca. 76°42′ N. lat. ca. 18°35′ W. long.
20 m above sea level. 10. 8. 1907.

Mya truncata L.
1 fragment of a large shell.

Saxicava arctica L.
4 shells, 28—31 mm, of the *arctica*-form, fairly thick in the shell

X. Cape Helgoland,
76°43′ N. lat. 19°10′ W. long.
ca. 10 m above sea level.

Astarte borealis CHEMNITZ.
1 shell, 31 mm.

Saxicava arctica L.
7 shells, 29—46 mm, some of an elongated *arctica*-form, others as *pholadis*, medium thickness, two enormously thickened.

XI. North of Cape Bismarck,
ca. 76°45′ N. lat. ca. 18°40′ W. long.
ca. 10 m above sea level.

Pecten islandicus MÜLLER.
Fragments of 2 shells, one small, one larger.

XII. Ostre Havnenæs,
76°45′ N. lat. 18°44′ W. long.
ca. 10 m above sea level.

Saxicava arctica L.
56 shells, 21—38 mm, mostly of an elongated *arctica*-form and thick-shelled, some extremely so.

XIII. Slopes of river bank near Danmarks Havn,
76°46′ N. lat. ca. 18°45′ W. long.
Altitude less than 10 m.

Astarte borealis CHEMNITZ.
3 shells, 23—28 mm.

Mya truncata L.
5 shells, 28—53 mm, some of var. *uddevallensis*, others of a somewhat longer form; one (the largest) truncate-ovate.

Saxicava arctica L.
4 shells, 31—37 mm, of an elongated *arctica*-form, some very thick in the shell, others rather thin.

XIV. Plain near Snenæs,
76°49′ N. lat. 19°25′ W. long.

ca. 5 m above sea level. August 1906.

Astarte borealis Chemnitz.

9 shells, 18·5—33 mm.

Mya truncata L.

4 shells, 32—53 mm, short or of medium lenght.

Saxicava arctica L.

15 shells, 23—40 mm, some of an elongated *arctica*-form, others as *pholadis*, medium thickness, some enormously thick.

XV. Yoldia clay, nearly due north of Snenæs,
76°50′ N. lat. 19°25′ W. long.

ca. 30—40 m above sea level.

Yoldia arctica Gray var. *portlandica* Hitch.

1 spec. and 3 shells, 9—11 mm, also some fragments.

Saxicava arctica L.

Some fragments of medium sized specimens.

XVI. Hvalsletten,
ca. 76°55′ N. lat. ca. 20°10′ W. long.

1. ca. 2 m above sea level.

Cardium ciliatum Fabricius.

2 shells of same specimen, much eroded, adult size (52 mm).

2. 0—10 m above sea level.

Modiolaria lævigata Gray var. *substriata* Gray.

2 shells of same individual, a small one. (Length 8 mm).

Astarte Banksii Leach.

4 shells, 10—19 mm.

Astarte borealis Chemnitz.

27 shells, 5—34 mm.

Cardium groenlandicum Chemnitz.

1 shell of an adult specimen (69 mm) and 7 fragments (ca. 42—60 mm).

Mya truncata L.

14 shells, length 22—62 mm. Most are of a short form, either var. *uddevallensis*, or approaching this, but the two largest shells (from one and the same individual) are of fairly elongated shape, and belong, apparently (the hinder edge is broken off) to the var. *ovata*.

Saxicava arctica L.

15 shells, 9·5—37 mm long, some of the *arctica*-form, others of

an elongated *arctica*-form or *pholadis*-form; 6 shells exhibit holes made by *Natica*.

Thracia septentrionalis JEFFREYS.

4 shells (one bored by *Natica*), of the following dimensions:

Length	Height
20 mm	15 mm
21·5 „	15·5 „
21·75 „	15·75 „
31·5 „	23·5 „

Natica affinis GMELIN.

13 shells. The largest of the unbroken shells measures 19 mm, one of the broken specimens, however, must have been considerably larger.

Trophon clathratus L.

2 spec., 14—28·5 mm, and a fragment of a medium sized individual.

Buccinum Belcheri REEVE.

2 adult specimens and a fragment of a young one.

Principal dimensions of the adult specimens as follows:

	mm	mm
Length (minus apex, which is broken off in both specimens)	46·5	51·5
Greatest diameter	27	29
Length of aperture	23	25·5
Breadth of do.	15	16.5

The sculpture fairly well preserved, exhibiting the spiral ribs and delicate spiral lines characteristic of the species.

The area of distribution of this species belongs to the extreme Arctic: Dobbin Bay, Grinnell Land, 30 fath (SMITH); Port Refuge (Wellington Channel), 11 fath (REEVE); W. Greenland (POSSELT); E. Greenland (77°31′ N. lat. 18°24′ W. long), 275 metres (GRIEG); Jan Mayen (FRIELE).

Buccinum sp.

A fragment.

Sipho (Tritonofusus) Kröyeri MØLLER.

2 adult specimens, fragmentary, but form and parts of sculpture sufficiently well preserved to permit of our regarding the determination as certain.

Strongylocentrotus dröbachiensis MÜLLER.

A small fragment of the shell.

3. From the stretch of clay north of Salmon River, abt. 10 m above sea level.

Yoldia (Portlandia) arctica Gray var. *portlandica* Hitch.

1 spec., 10 mm.

XVII. From the terminal moraine in front of the Glacier to Sælsøen, 77°4′ N. lat. 21°54′ W. long.

5 à 10 m above sea level. March 1908.

Astarte borealis Chemnitz.

2 shells, 25 mm.

Tellina (Macoma) Loveni Steenstrup.

1 shell (the right), 11 mm.

Cardium groenlandicum Chemnitz.

Fragment of a medium sized shell.

Mya truncata L.

1 shell, posteriorly obliquely cut off forward, medium thickness.

Saxicava arctica L.

5 shells, 30—45 mm, of an elongated *arctica*-form.

Calcareous algæ (*Lithothamnion*) on shell fragments of *Sipho* (?).

XVIII. Moraine country near camping ground below the Jökel, 77°29′ N. lat. 21°43′ W. long.

Mya truncata L.

A fragment.

Saxicava arctica L.

A fragment.

Apomatus globifer Théel.

Fragment of a tube.

XIX. Edge of the inland ice ("Moraine country")[1], 1. 77°30′ N. lat., 21°42′ W. long.

ca. 15 m above sea level. 5. 5. 1908.

Mya truncata L.

A fragment.

Balanus porcatus da Costa.

Part of a shell.

2. 77°31′ N. lat. 21°37′ W. long.

ca. 65 m above sea level. 10. 5. 1908.

Saxicava arctica L.

4 shells, 28—34 mm, of an elongated *arctica*-form and of *pholadis*-form.

[1]) cf. Meddelelser om Grønland, Vol. XLVI, p. 43-48, fig. 51-54.

XX. Cape Amélie,
ca. 77°31′ N. lat. ca. 19°15′ W. long.

Sloping mound of stratified sand and moraine-gravel in front of a glacier-wall. 0—5 m above sea level. 7. 10. 1906.

Astarte borealis CHEMNITZ.

2 medium sized shells, with well-preserved periostracum.

Mya truncata L.

A quantity of fragments of adult specimens.

Saxicava arctica L.

Some fragments.

XXI. Ile de France,
ca. 77°36′ N. lat. ca. 18° W. long. 23. 4. 1907.

Yoldia (Portlandia) arctica GRAY.

1 spec., 13 mm, in a piece of clay. In a number of other lumps of clay from same locality traces of *Yoldia arctica* were also found, likewise a fragment of *Dentalium* (?).

XXII. East coast of Holms Land,
ca. 80°15′ N. lat. ca. 16°30′ W. long.

ca. 10 m above sea level, a few hundred m from coastline.

Mya truncata L.

2 shells, one a fragment, the other fairly thick and short in the shell, 50 mm.

XXIII. Ingolfs Fjord, North side,
ca. 80°40′ N. lat. ca. 16°50′ W. long.

ca. 20 m above sea level.

Astarte borealis CHEMNITZ.

2 small shells, fragments.

Mya truncata L.

9 shells, 35—48 mm, some short, posteriorly obliquely cut off forward, others moderately elongated.

XXIV. Easternmost point of Greenland,
81°26′ N. lat. 12° W. long.

Sample taken in the inland ice, ca. 50 m above sea level.

Mya truncata L.

A few fragments.

XXV. East coast of Peary Land,
82°46′ N. lat. 21°5′ W. long.

A few km from coastline, ca. 10 m above sea level.

Yoldia (Portlandia) arctica Gray.

Fragments of two medium sized shells, with well-preserved periostracum.

Clay samples from same place contained *Foraminifera.*

XXVI. Peary Land, North side of Hyde Fjord,
83°15′ N. lat. 27° W. long.

20 m above sea level.

Saxicava arctica L.

2 shells of *arctica*-form, one fairly thick in the shell, 35—36 mm.

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